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STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

CALIFORNIA

MINERAL PRODUCTION

FOR 1946

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BULLETIN 139

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

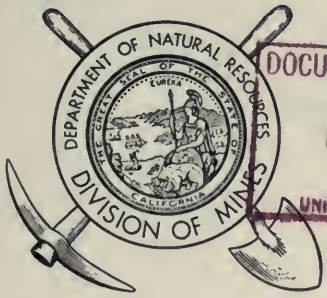
STATE OF CALIFORNIA
EARL WARREN, Governor
DEPARTMENT OF NATURAL RESOURCES
WARREN T. HANNUM, Director

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO
OLAF P. JENKINS, Chief

San Francisco] BULLETIN 139 [April 1948

CALIFORNIA MINERAL PRODUCTION FOR 1946

By
C. V. AVERILL, C. R. KING, HENRY H. SYMONS
and F. F. DAVIS



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LETTER OF TRANSMITTAL

To His Excellency,
THE HONORABLE EARL WARREN
Governor of the State of California

Dear Sir:

I have the honor to transmit herewith Bulletin 139, "California Mineral Production for 1946," prepared by C. V. Averill, C. R. King, Henry H. Symons and F. F. Davis, members of the staff of the Division of Mines. This report represents the Division's annual statistical bulletin covering the State's mineral resources. It has been submitted for publication by the Chief of the Division of Mines, Olaf P. Jenkins.

In value of annual mineral production, California is exceeded only by Texas and Pennsylvania, the first because of its large petroleum and natural gas production and the second because of its vast coal resources. In different kinds of mineral substances produced, however, California far exceeds other states, contributing more than any other natural resource, besides agriculture, to the industrial growth of the great commonwealth.

Improvement has been made in this report over previous statistical bulletins by the addition of data concerning the marketing of minerals and their utilization.

Respectfully submitted,

February 17, 1948

Warren T. Hannum
Director, Department of
Natural Resources.

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MAP OF
CALIFORNIA
SHOWING THE
DISTRIBUTION OF PRINCIPAL MINERAL RESOURCES
PREPARED BY THE
STATE DIVISION OF MINES
SCALE
1945
OREGON
DEL NORTE
SISKIYOU
MODOC
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
NEVADA
LAKE
COLUSA
SUTTER
YUBA
PLACER
EL DORADO
YOLO
NAPA
SONOMA
SOLANO
SACRAMENTO
ALPINE
CALAVERAS
SAN JOAQUIN
TUOLUMNE
MONO
CONTRA COSTA
ALAMEDA
STANISLAUS
MARIPOSA
SAN MATEO
SANTA CLARA
MERCED
MADERA
SANTA CRUZ
SAN BENITO
FRESNO
INYO
MONTEREY
TULARE
KINGS
SAN LUIS OBISPO
KERN
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL
MEXICO
ARIZONA
NEVADA
PACIFIC
OCEAN
MINERAL RESOURCES
ANDALUSITE & KYANITE
BARITE
BORAX
BUILDING STONE
CARBON DIOXIDE GAS
CHROMITE
CLAY
COAL
COPPER
DIATOMITE
DOLOMITE
FELDSPAR
FELDSPAR & SILICA (QUARTZ)
GOLD DISTRICTS
GOLD (SMALL AREAS OR MINES)
GYPSUM
IRON
LEAD
LIMESTONE, CEMENT & MARBLE
MAGNESITE
MANGANESE
POTASH
PUMICE & VOLCANIC ASH
PYRITES
QUICKSILVER
SALT
SILICA (QUARTZ)
SILICA (SAND)
SILVER
SODA
SULFUR
TALC & SOAPSTONE
TITANIUM
TUNGSTEN
ZINC
GAS DISTRICTS
OIL & GAS DISTRICTS
CITIES
NOTE
COMBINED SYMBOLS SHOW TWO OR MORE MINERALS OCCUR AT SAME LOCALITY
BORAX, SODA
COPPER, ZINC

INTRODUCTION

The recent accelerated shift to California of both population and industry has caused an intensified building boom in this state, accompanied by a tremendous demand for the materials used in construction. Crude products necessary in the manufacture of structural materials include minerals and rocks. The critical shortage of lumber is causing substitution by mineral products. The cement mills of California are running near capacity, and the state is now leading all others in production of this ingredient of concrete. This means that the production of crushed rock, sand, and gravel necessary for aggregate is also at a high level. Other mineral raw materials that are in great demand for building are clay for brick and tile, gypsum for plaster and wall-board, and pumice for light-weight aggregate in concrete and building blocks. The artificial pumice known as expanded perlite, for which volcanic glass is the raw material, will probably soon be produced in quantity.

Among mineral raw materials demanded in large quantities by the expanding industries of California is limestone used as flux in smelting metals, in agriculture, in mortar, plaster, glass, fruit sprays, water-purification, sugar-refining, manufacture of paper, and in many smaller industries. Soda ash used in glass and soap and as a chemical in the manufacture of many other products is in very high demand. Additions to existing plants are being built at Searles Lake, a new plant has been completed at Owens Lake, and the demand still exceeds the supply. Other industrial minerals, the production of which continues at a high level, include borates for use in glass, enamels, drugs, and many other products; bentonite and barite used in oil-well drilling muds; diatomite for filtration and insulation; iodine for drugs and chemicals; potash for fertilizer; and talc for paints, ceramics, toilet preparations, and insecticides.

For fuel California depends upon her enormous deposits of petroleum and natural gas rather than upon coal. Annual production of petroleum in California is many times as great in value as that of any other mineral substance, and the 1947 production is expected to be the greatest on record. Although new discoveries are being made in the state, supply is not keeping up with demand, and some petroleum is being imported. Natural gas is in such high demand that a 30-inch pipe line is being constructed to bring this fuel from Texas to California.

The condition of the metal-mining industry in California shows a mixed trend. The production of metals is not rising in the same measure as that of most structural and industrial minerals. The new pig-iron industry at Fontana continues to run at capacity, and new facilities are being added for the manufacture of additional types of steel. Production of lead, particularly at Darwin, Inyo County, continues at essentially the same rate as during the war. Tungsten mining, however, almost ceased after the war because of the drop in price, but now the price is rising and the industry is reviving. Quicksilver production is low because of the low price of the metal. Output of copper and zinc is low largely because known reserves were depleted during the war. Some development of new reserves is under way. Aluminum and magnesium were both produced in California during the war, but the plants have been closed. Gold mining was all but shut down during the war by order

Table 1. Amount and value of mineral substances produced in California in 1945 and 1946

Substance	1945		1946		Value of increase(+) or decrease(—)
	Amount	Value	Amount	Value	
Borates	257,299 tons	$5,898,823	332,157 tons	$7,230,925	$1,332,102+
Brick and hollow tile		3,523,661		5,565,075	2,041,414+
Cement	15,922,772 bbls.	23,469,027	19,546,336 bbls.	32,403,081	8,934,054+
Chromite	9,784 long tons	431,445	[a]	[a]	—
Clay (pottery)	497,586 tons	1,345,966	604,140 tons	1,606,256	260,290+
Copper	13,949,675 lbs.	1,883,206	8,377,352 lbs.	1,357,131	526,075—
Gold	147,938 fine ozs.	5,177,830	356,824 fine ozs.	12,488,840	7,311,010+
Granite		220,411		275,367	54,956+
Gypsum	442,133 tons	954,696	618,007 tons	1,431,884	477,188+
Iron ore	240,917 tons	883,434	428,354 tons	1,061,956	178,522+
Lead	14,504,767 lbs.	1,247,410	20,432,630 lbs.	2,227,157	979,747+
Limestone	532,480 tons	1,626,844	767,170 tons	1,974,479	347,635+
Manganese ore	1,875 long tons	86,270			—
Mineral water	26,502,875 gals.	798,430	33,397,902 gals.	1,132,399	333,696+
Natural gas	538,273,934 M cu. ft.	35,362,313	516,263,710 M cu. ft.	46,905,877	11,543,564+
Petroleum	328,262,400 bbls.	342,756,767	317,116,874 bbls.	386,812,146	44,055,379+
Platinum group metals	145 fine ozs.	6,719	[a]	[a]	—
Pumice and volcanic ash	89,209 tons	461,022	109,191 tons	540,811	79,789+
Quicksilver	21,062 flasks	2,697,835	17,804 flasks	1,648,758	1,049,077—
Salt	734,736 tons	2,030,226	796,761 tons	2,274,722	244,496+
Sandstone		7,498	2,286 tons	25,764	18,266+
Silica (glass sand and quartz)	581,725 tons	1,309,564	594,155 tons	1,408,553	98,989+
Silver	986,798 fine ozs.	701,723	1,342,651 fine ozs.	1,084,862	383,139+
Soapstone, talc and pyrophyllite	65,202 tons	922,682	74,146 tons	945,294	22,612+
Soda (saltcake and soda ash)	311,236 tons	3,793,571	362,015 tons	4,476,553	682,982+
Stone, miscellaneous[1]	29,449,484 tons	20,207,351	41,610,212 tons	27,671,788	7,464,437+
Tungsten ore	71,511 units	1,587,951	102,513 units	2,072,680	484,729+
Zinc	19,340,732 lbs.	2,224,184	14,639,804 lbs.	1,786,056	438,128—
Unapportioned	[c]	12,044,732	[b]	13,041,082	996,350+
Total value		$473,661,591		$559,449,496	
Net increase					$85,787,905

[1] Includes macadam, crushed rock, ballast, rubble, riprap, sand and gravel.

[a] Included under Unapportioned.

[b] Includes asbestos, barite, bentonite, bituminous rock, bromine, calcium chloride, carbon dioxide, chromite, coal, diatomite, dolomite, feldspar, gems, iodine, lithia, magnesia and magnesium salts, marble, mica (sericite), mineral paint, molybdenum ore, platinum-group metals, potash, pyrite, serpentine, sillimanite group (kyanite), slate, strontium, titanium, grinding-mill pebbles.

[c] Includes asbestos, barite, bentonite, bituminous rock, bromine, calcium chloride, carbon dioxide, coal, diatomite, dolomite, feldspar, garnets (abrasive), gems, iodine, lithia, magnesite, magnesia, mica (sericite), mineral paint, potash, pyrite, sillimanite group, slate, strontium, grinding-mill pebbles.

Table 2. Comparative value of mineral production of counties in California for 1945 and 1946

County	1945	1946	County	1945	1946	County	1945	1946
Alameda	$6,661,939	$4,860,314	Mendocino	118,767	383,431	Santa Barbara	22,643,580	28,102,174
Alpine	1,500	1,000	Merced	285,363	321,158	Santa Clara	5,810,388	8,568,863
Amador	487,544	752,464	Modoc	193,156	75,418	Santa Cruz	2,015,407	2,363,898
Butte	663,610	947,171	Mono	91,928	84,868	Shasta	2,119,802	2,420,213
Calaveras	2,789,881	3,432,594	Monterey	3,018,280	2,044,423	Sierra	172,782	403,174
Colusa	7,083	93,784	Napa	628,974	1,018,955	Siskiyou	926,305	653,147
Contra Costa	2,496,533	3,266,972	Nevada	1,196,433	1,987,650	Solano	5,282,725	6,254,628
Del Norte	341,306	91,919	Orange	35,178,471	41,404,311	Sonoma	807,122	859,077
El Dorado	301,627	838,234	Placer	241,359	228,968	Stanislaus	406,727	1,103,654
Fresno	51,677,246	59,204,945	Plumas	41,243	192,176	Sutter	62,910	73,248
Glenn	72,046	141,508	Riverside	4,644,406	6,320,268	Tehama	69,921	64,850
Humboldt	201,514	293,859	Sacramento	9,240,880	13,821,490	Trinity	91,560	514,883
Imperial	383,431	726,044	San Benito	1,949,386	1,572,291	Tulare	256,764	669,333
Inyo	4,258,250	6,218,539	San Bernardino	23,038,011	30,515,887	Tuolumne	434,626	399,967
Kern	126,716,070	133,082,652	San Diego	1,142,350	1,729,393	Ventura	29,352,740	37,333,004
Kings	13,568,174	15,604,139	San Francisco	75,172	38,182	Yolo	479,810	487,812
Lake	197,448	161,844	San Joaquin	1,256,594	2,230,561	Yuba	1,186,139	2,273,106
Lassen	20,635	177,090	San Luis Obispo	497,923	299,274	Total value	$473,661,591	$559,449,496
Los Angeles	103,641,827	124,946,810	San Mateo	2,363,508	5,917,877			
Madera	189,886	391,363						
Marin	491,435	871,162						
Mariposa	1,171,094	613,477						

of the War Production Board. The output is still low but is rising. Manganese production has dropped to a low level.

Details of the condition of the mineral industries in 1947 appear on the following pages. Arrangement is alphabetical, first for fuels, second for metals, third for industrial non-metallc minerals, and fourth for salines. Some information on markets is included.

SUMMARY OF THE MINERAL INDUSTRY IN CALIFORNIA DURING THE YEAR 1946[1]

The total value of the mineral output in California during the year 1946 was $559,449,496, an increase of $85,787,905 over the 1945 total of $473,661,591. The increase resulted from higher prices paid for petroleum and natural gas, and an increased output (owing to an unprecedented demand) for salines, structural materials, and certain industrial minerals. A total of 61 commercial mineral substances were listed during the year excluding the segregation of various stones grouped under gems. All 58 counties of the state contributed to the list.

The salient features of 1946 mineral production as compared with the previous year were: all groups of mineral substances showed an increase in total value; the total value of mineral production was the largest on record. Mineral substances recording new all-time highs in both amount and value of annual output were: borates, diatomite, gypsum, iodine, limestone, mica, potash, pumice and volcanic ash, silica (glass sand and quartz), soapstone and talc, and soda (soda ash and saltcake). Barite, carbon-dioxide gas, clay (pottery), lead, petroleum, natural gas and miscellaneous stone, recorded all-time highs in value of production for a single year. Salt and serpentine recorded all-time highs in amount of production for a year, but the value of production was exceeded in 1929 and 1896 respectively.

Fuels. Petroleum production was 328,262,400 barrels worth $342,-756,767 in 1945 and 317,116,874 barrels valued at $386,812,146 in 1946, a decrease of 3.4 percent in amount and an increase of 12.8 percent in value. The 1946 value was the greatest on record, but in 1945 the number of barrels produced was the largest. This was accounted for by the average value of crude oil at the well in California which was $1.044 in 1945 and $1.22 in 1946. Natural-gas production was 538,273,934 M cubic feet worth $35,362,313 in 1945 and 516,263,710 M cubic feet worth $46,905,877 in 1946.

Metals. Increases in annual production value over 1945 were recorded for gold, lead, iron ore, platinum-group metals, silver, and tungsten ore; all others showed a decline in quantity and value. The value of gold produced increased from $5,177,830 in 1945 to $12,488,840; copper decreased from 13,949,675 pounds worth $1,883,206 to 8,377,352 pounds worth $1,357,131; lead increased from 14,504,767 pounds worth $1,247,410 to 20,432,630 pounds worth $2,227,157—the largest yield for a year of this metal so far reported; quicksilver decreased from 21,062 flasks worth $2,697,835 to 17,804 flasks worth $1,648,758; silver increased from 986,798 fine ounces worth $701,723 to 1,342,651 fine ounces worth $1,084,862; tungsten ore increased from 71,511 units worth $1,587,-951 to 102,513 units worth $2,072,680; and zinc decreased from 19,340,732 pounds worth $2,224,184 to 14,639,804 pounds worth $1,786,056.

[1] Data compiled from direct returns from producers in answer to inquiries sent out by the California State Division of Mines, Ferry Building, San Francisco, California.

Table 3. Comparative value of annual production of all mineral products, gold, and petroleum in California, 1887-1946

Year	Total value of all minerals	Gold, value	Petroleum, value	Year	Total value of all minerals	Gold, value	Petroleum, value
1887	$19,785,868	$13,588,614	$1,357,144	1918	199,753,837	16,529,162	127,459,221
1888	19,469,320	12,750,000	1,380,666	1919	195,830,002	16,695,955	142,610,563
1889	16,681,731	11,212,913	368,048	1920	242,099,667	14,311,043	178,394,937
1890	18,039,666	12,309,793	384,200	1921	268,157,472	15,704,822	203,138,225
1891	18,872,413	12,728,869	401,264	1922	245,183,826	14,670,346	173,381,265
1892	18,300,168	12,571,900	561,333	1923	344,024,678	13,379,013	242,731,309
1893	18,811,261	12,422,811	608,092	1924	374,620,789	13,150,175	274,652,874
1894	20,203,294	13,923,281	1,064,521	1925	434,519,660	13,065,330	330,609,829
1895	22,844,663	15,334,317	1,000,235	1926	450,330,856	11,923,481	345,546,677
1896	24,291,398	17,181,562	1,180,793	1927	366,781,394	11,671,018	260,735,498
1897	25,142,441	15,871,401	1,918,269	1928	332,224,233	10,785,315	229,998,680
1898	27,289,079	15,906,478	2,376,420	1929	432,248,228	8,526,703	321,366,863
1899	29,313,460	15,336,031	2,660,793	1930	365,604,695	9,451,162	271,699,046
1900	32,622,945	15,863,355	4,152,928	1931	215,964,420	10,814,162	141,835,723
1901	34,355,981	16,989,044	2,961,102	1932	199,196,493	11,765,726	142,890,247
1902	35,069,105	16,910,320	4,692,189	1933	206,489,058	15,683,075	143,063,972
1903	37,759,040	16,471,264	7,313,271	1934	237,374,709	25,131,284	159,529,671
1904	43,778,348	19,109,600	8,317,809	1935	263,404,317	31,165,050	179,335,311
1905	43,069,227	19,197,043	9,007,820	1936	327,804,268	37,710,470	211,667,185
1906	46,776,085	18,732,452	9,238,020	1937	361,515,951	41,110,230	237,845,872
1907	55,697,949	16,727,928	16,783,943	1938	380,444,976	45,889,515	258,354,343
1908	66,363,198	18,761,559	26,566,181	1939	352,462,564	50,234,240	226,358,856
1909	82,972,209	20,237,870	32,398,187	1940	342,825,817	50,948,485	207,479,800
1910	88,419,079	19,715,440	37,689,542	1941	374,326,228	49,307,755	218,838,171
1911	87,497,879	19,738,908	40,552,088	1942	408,738,434	29,679,895	242,481,545
1912	88,972,385	19,713,478	41,868,344	1943	426,445,280	5,191,480	289,323,406
1913	98,644,639	20,406,958	48,578,014	1944	469,774,525	4,108,055	330,659,802
1914	93,314,773	20,653,496	47,487,109	1945	473,661,591	5,177,830	342,756,767
1915	96,663,369	22,442,296	43,503,837	1946	559,449,496	12,488,840	386,812,146
1916	127,901,610	21,410,741	57,421,334				
1917	161,202,962	20,037,504	86,976,209	Totals	$11,451,383,009	$1,120,576,843	$7,362,327,509

Industrial Non-Metallic Group. The total value of the industrial non-metallic group increased from $59,695,692 in 1945 to $80,568,182. Many important materials under this classification showed an increase in amount and value over the preceding year, several of them reaching all-time highs. Cement increased from 15,922,722 barrels worth $23,469,027 in 1945 to 19,546,336 barrels worth $32,403,081 in 1946; miscellaneous stone increased from a total value of $20,207,351 to $27,671,788; other important minerals under this classification whose total value exceeded a million dollars and which showed a gain over the previous year in total output were brick and hollow building tile, pottery clay, gypsum, limestone, mineral water, silica (quartz and glass sand), and diatomite.

Salines. Production in the saline group increased from a total value of $18,918,432 in 1945 to $21,267,532 in 1946. Borates, potash, salt, soda (soda ash and salt cake), bromine, calcium chloride, and iodine registered larger outputs and values. The only material showing a decrease in output was magnesia.

CHAPTER ONE

FUELS

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INTRODUCTION

Fuels are among the most important mineral products of California. They include coal, natural gas, and petroleum, and make up practically 78 percent in value of the state's entire mineral output for the year 1946.

Peat deposits are known in several locations in California. Small amounts of peat are used as soil conditioner and in livestock feed, but there is no record of its use as a fuel.

Table 4. Comparison of 1945 and 1946 output of fuels in California

Substance	1945		1946		Value of increase(+) decrease(—)
	Amount	Value	Amount	Value	
Coal (see Table 5)					
Natural gas	538,273,934 M cu. ft.	$35,362,313	516,263,710 M cu. ft.	$46,905,877	$11,543,564+
Petroleum	328,262,400 bbls.	342,756,767	317,116,874 bbls.	386,812,146	44,055,379+
Total values		$378,119,080		$433,718,023	
Net increase					$55,598,943+

COAL

Bibliography: State Mineralogist Rept. 7, 12-15 (inc.), 17, 19-28 (inc.), 31, 35, 37, 39. U. S. Geol. Survey Bull. 285, 316, 421, 431, 471, 581; Ann. Rept. 22, pt. 3.

California coal production has come chiefly from the Mount Diablo district in Contra Costa County and the Tesla district in Alameda County, but smaller amounts have been mined in Amador, Fresno, Monterey, Orange, Riverside, Shasta, Siskiyou, and Trinity Counties. Reserves are estimated to be more than 100 million tons, those of Mendocino and Shasta Counties alone having been estimated at 35 million tons. The coal is classed as non-coking bituminous, sub-bituminous, and lignite.

Coking coal is imported from Utah and the by-products produced in the coking process offer competition to similar products which could be produced from California coals. The competitive position of California coal will improve as the supplies of petroleum and natural gas are depleted and as the demand for fuels increases with the expansion of industry and the increase in population.

Constant improvements are being made in machines, methods, and equipment used in mining, processing, and utilizing coal. Flat coal beds are stripped and mined with power shovels. The sink and float process, jigs, and classifiers, have made it possible to produce clean coal from beds having many shale partings. Burners using powdered coal, mechanical stokers, and briquetting machines have created a market for grades of coal previously unsaleable. Experiments are being made to determine the feasibility of producing gas by the controlled combustion of coal beds in place, and manufacturing gasoline, fuel, and lubricating oils from coal. These developments indicate that the coal deposits of California may some day be an important source of industrial fuel. In 1947, a coal deposit in Amador County was being developed and equipped to produce, and a very small production has recently been made in Trinity County.

Table 5. Annual tonnage and value of coal produced in California, 1861-1946

(Tonnages 1861-66, inclusive, from Mineral Resources U. S., 1910, p. 107; values prior to 1883 (average $5.75 per ton), from W. A. Goodyear, Mineral Resources U. S., 1882, pp. 93-94; figures after 1887 compiled by State Division of Mines.) NOTE: Production figures for 1939-46 have been combined in 2-year periods to conceal output of individual producers.

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1861	6,620	$38,065	1889	121,280	$288,232	1917	3,527	$7,691
1862	23,400	134,550	1890	110,711	283,019	1918	6,343	16,149
1863	43,200	248,400	1891	93,301	204,902	1919	2,983	8,203
1864	50,700	291,525	1892	85,178	209,711	1920	2,078	5,450
1865	60,530	348,048	1893	72,603	167,555	1921	12,467	63,578
1866	84,020	483,115	1894	59,887	139,862	1922	27,020	135,100
1867	124,690	716,968	1895	79,858	193,790	1923	1,010	5,090
1868	143,676	826,137	1896	70,649	161,335	1924	1,425	8,800
1869	157,234	904,096	1897	87,449	196,255	1925	730	3,880
1870	141,890	815,868	1898	143,045	337,475	1926	1,100	5,000
1871	152,493	876,835	1899	160,941	420,109	1927	200	1,100
1872	190,859	1,097,439	1900	176,956	535,531	1928	782	4,542
1873	186,611	1,073,013	1901	150,724	401,772	1929	450	2,476
1874	215,352	1,238,274	1902	88,460	248,622	1930	10,885	59,858
1875	166,638	958,169	1903	93,026	265,383	1931	12,551	77,607
1876	128,049	736,282	1904	79,062	376,494	1932	9,508	36,468
1877	107,789	619,787	1905	46,500	144,500	1933	2,612	11,367
1878	134,237	771,863	1906	24,850	61,600	1934	13,549	52,720
1879	147,879	850,304	1907	23,734	55,849	1935	8,049	32,745
1880	236,950	1,362,463	1908	18,496	55,503	1936	370	1,815
1881	140,000	805,000	1909	49,389	216,913	1937	269	2,933
1882	112,592	647,404	1910	11,033	23,484	1938	275	1,650
1883	76,162	380,810	1911	11,047	18,297	1939-40	1,750	8,100
1884	77,485	309,950	1912	14,484	39,092	1941-42	190	1,046
1885	71,615	286,460	1913	25,198	85,809	1943-44	219	1,721
1886	100,000	300,000	1914	11,859	28,806	1945-46	149	754
1887	50,000	150,000	1915	10,299	26,662			
1888	95,000	380,000	1916	4,037	7,030	Totals	5,270,218	$23,400,260

NATURAL GAS

Bibliography: State Mineralogist Rept. 7, 10, 12, 13, 14, 29, 37; Bull. 3, 16, 19, 69, 73, 89, 118. Summary Oil and Gas Supervisor Dec. 1919, Aug. 1922, Mar. 1923, Mar. and Apr. 1926.

Solano County is the most important producer of dry gas and has the greatest amount of new drilling activity. New producing wells recently have been drilled in three different areas in this county and in the Thornton area of Sacramento County. In the Rio Vista field (Solano County), 132 wells were connected to pipe lines at the beginning of 1947. Farther to the north three new dry-gas areas have been developed. One is a discovery in the Winters area; the second is in the Dunnigan Hills area, Yolo County, 12 miles northwest of Woodland; and the third is in the Durham area of Butte County 5 miles south of Chico.

Table 6. Production of natural gas during 1946, by county

NOTE: These figures represent only utilized natural gas; they do not include gas wasted or stored in formation. Production figures for counties having only one producing company are combined, to conceal output of individual producers.

County	M cu. ft.	Value	County	M cu. ft.	Value
Fresno	55,454,786	$4,806,207	Solano	61,468,903	$6,228,130
Kern	72,945,848	5,694,426	Ventura	49,579,660	4,250,873
Kings	41,778,881	3,618,803	Butte, Contra Costa, Humboldt,		
Los Angeles	89,543,147	7,718,409	Glenn, Madera, Stanislaus,		
Orange	27,489,820	2,305,823	Sutter, Tulare and Yolo	14,011,413	1,377,072
Sacramento	81,027,875	8,639,377			
San Joaquin	9,524,708	987,399	Totals	516,263,710	$46,905,877
Santa Barbara	13,438,669	1,279,358			

The Trico gas field is in the extreme southwest corner of Tulare County near the southeast corner of Kings County, and extends a short distance into Kern County. Recent drilling has developed an extension of this field to the northwest to almost double the proved acreage available for production. A new gas zone has been discovered 800 feet deeper than the old one, and this new zone is expected to produce as much gas as the old one, adding greatly to the reserves of the field.

Natural gas is a mineral of high value in California, the annual production being several times as valuable as the 1946 production of gold. Gas is produced from two types of fields. In one type the gas is produced as a by-product of oil production; and in the other type, known as dry gas fields, no oil accompanies the gas.

Special Study No. S-584 of the State Department of Natural Resources and the California Public Utilities Commission, released in May 1947, indicates that, with the present production facilities, a number of areas in California would be inadequately served with gas on a day as cold as the coldest day on record in the last 20 years. Included in these areas are the peninsula district on San Francisco Bay and the metropolitan district of Los Angeles.

A pipe line 30 inches in diameter is being constructed from Texas to California and is expected to be completed by the end of 1947. Other pipeline facilities that will help to increase supplies of natural gas include a line from the Kettleman Hills to a point near Pittsburg. This line has been restored to gas service after having been leased for delivery of oil since 1942. This line is primarily 26-inch, but contains some 22-inch pipe. A new line has recently been built from Rio Vista and nearby fields not previously drawn upon. It contains 36 miles of pipe ranging in diameter from 4 to 12 inches. A number of other new lines have been built in the Livermore, Chico, and Trico areas.

Statistics on the production of natural gas in California are difficult to compile, as much of the gas used directly at the wells for heating, lighting, and driving gas engines is not measured. Hence it is necessary to

Table 7. Annual volume and value of natural gas produced in California, 1888-1946

NOTE: From 1888-98 and 1911-12, inclusive, some operators reported values only; volume (M cu. ft.) estimated from values. Statistical bulletins issued prior to 1933 included carbon-dioxide production (1894-96 inclusive) with natural-gas figures; in later bulletins carbon dioxide is included under industrial materials.

Year	M cubic feet	Value	Year	M cubic feet	Value	Year	M cubic feet	Value
1888	12,000	$10,000	1909	1,148,467	$616,932	1929	400,129,201	$29,675,546
1889	14,500	12,680	1910	10,579,933	1,676,367	1930	315,513,952	24,559,840
1890	41,250	33,000	1911	5,000,000	491,859	1931	344,959,920	16,690,695
1891	39,000	30,000	1912	12,600,000	940,076	1932	284,168,872	16,272,061
1892	75,000	55,000	1913	14,210,836	1,053,292	1933	271,743,544	15,403,514
1893	84,000	68,500	1914	16,529,963	1,049,470	1934	263,207,517	14,408,761
1894	85,000	75,000	1915	21,992,892	1,706,480	1935	302,447,193	17,680,661
1895	110,000	100,000	1916	28,134,365	2,871,751	1936	298,922,708	18,585,940
1896	131,000	110,157	1917	44,343,020	2,964,922	1937	323,833,714	19,859,365
1897	71,300	62,657	1918	46,373,052	3,289,524	1938	332,358,439	22,310,755
1898	111,165	74,424	1919	52,173,503	4,041,217	1939	340,754,804	21,551,646
1899	115,110	95,000	1920	58,567,772	3,898,286	1940	352,871,945	20,618,983
1900	40,566	34,578	1921	67,043,797	4,704,678	1941	378,173,737	21,522,445
1901	120,800	92,034	1922	103,628,027	6,990,030	1942	413,180,942	25,698,052
1902	120,968	99,443	1923	240,405,397	15,661,433	1943	443,219,847	28,046,729
1903	120,134	75,237	1924	209,021,596	15,153,140	1944	467,743,258	31,797,418
1904	144,437	91,035	1925	194,719,924	15,890,082	1945	538,273,934	35,362,313
1905	148,345	102,479	1926	214,549,477	19,465,347	1946	516,263,710	46,905,877
1906	168,175	109,489	1927	224,686,940	20,447,294			
1907	169,991	114,759	1928	260,887,116	22,260,947	Totals	8,417,178,938	$574,044,314
1908	842,883	474,584						

approximate the output of many of the operators in the oil fields by calculations involving the number of lights and the number and horsepower of gas engines and steam boilers thus operated. The figures here given are for gas utilized locally, or sold for distribution to consumers. They are considered conservative, particularly those for the seven oil-producing counties. Some important oil fields are many miles removed from the site of any other industry. Because of the distance they would have to be transported, the gathering of small amounts of gas from such fields may not be profitable. In many cases there are no pipe line facilities available to handle gas during early production in newly developed fields. Wherever feasible, casing-head gas is used in driving gas engines for pumping and drilling, and in firing the boilers of steam-driven plants.

Production and Value

Natural gas to the amount of 516,263,710 M cubic feet, worth $46,905,877 was produced and utilized (sold or used) in California during 1946 as reported to the Division of Mines, compared with 538,273,934 M cubic feet valued at $35,362,313 in 1945. The 1946 value of utilized natural gas is the largest on record in this state, but the amount of production fell short of the 1945 all-time high by 22,010,224 M cubic feet.

Increases in the amount of utilized natural gas over 1945 were reported in Butte, Contra Costa, Fresno, Glenn, Madera, Orange, San Joaquin, Tulare, and Yolo Counties; decreased outputs were registered in Humboldt, Kern, Los Angeles, Sacramento, Santa Barbara, Solano, Stanislaus, Sutter, and Ventura Counties. The value of the output from Sacramento County exceeded that of any other county, although the largest production came from Los Angeles County. Humboldt was the only county to report a decrease in both amount and value of natural gas produced. Los Angeles County led in quantity output from 1922-42, was exceeded in value in 1944 by both Sacramento and Solano Counties, and was passed in value in 1945 and 1946 by Sacramento County only.

A rather wide variation in prices is quoted for natural gas because a considerable part is used directly in the field for driving gas engines and firing boilers, and is therefore not measured or sold. Some companies have placed a valuation on gas thus used in 1946 giving from 3 to 39 cents per 1000 cubic feet at the well. From the totals shown in table 7 the average value for all fields in 1946 works out at approximately 9.08 cents per M cubic feet. Approximately 7000 cubic feet of gas is equal to one barrel of oil in heating value, and is so counted by many operators. In driving gas engines, about 4000 cubic feet per 24 hours are consumed by a 25-horsepower engine, and 63,700 cubic feet per day for heating a 70-horsepower steam boiler, which figures have been utilized in compiling this report, in those cases where gas was not metered.

Natural-Gas Production in California Since 1888

The production of natural gas in California by years since 1888 is given in table 7. The first natural gas put to economic use in California was from the famous courthouse well at Stockton, bored in 1854-58. Beginning about 1883 and for several succeeding years, a number of gas wells were brought in around Stockton, and later at Sacramento. Natural gas was known in a number of other localities, and occasionally utilized in a small way, notably at Kelseyville in Lake County, and in Humboldt County near Petrolia and Eureka; but there are no available authentic records of amounts or values prior to the year 1888.

Table 8. Production of natural-gas gasoline and liquefied petroleum gases during 1946, by county

County	Natural-gas gasoline		Liquefied natural gases	
	Gallons	Value	Gallons	Value
Fresno, Kings	110,260,566	$4,939,733	51,086,091	$1,430,410
Kern	100,520,342	4,037,384	34,954,571	946,700
Los Angeles	238,612,768	11,129,821	10,601,072	312,755
Orange	88,990,362	4,043,042	4,836,192	130,578
Santa Barbara	21,888,645	985,805	4,155,424	112,659
Ventura	83,657,697	3,346,010	14,215,167	369,249
Totals	643,930,380	$28,481,795	119,848,517	$3,302,351

Gasoline from Natural Gas

Gas usually accompanies the petroleum in the oil fields, and such gas carries varying amounts of gasoline. In 1946 there were 82 plants in operation recovering gasoline by absorption or compression from the "casing-head" gas. After the gasoline is extracted the remaining "dry gas" is taken into pipe lines, by which it is distributed to consumers, both domestic and commercial, used as plant fuel, or returned to the producer to use as fuel.

Natural-gas gasoline produced during 1946 was reported from all fields by 82 plants: a total of 643,930,380 gallons worth $28,481,795, as compared with 642,336,668 gallons worth $26,031,276 from 80 plants in 1945. In 1946 a total of 119,848,517 gallons of liquefied petroleum gases valued at $3,302,351 was produced, as compared with 141,846,564 gallons worth $3,505,085 reported for 1945.

The usual recoveries of gasoline from natural gas vary from half a gallon to 3 gallons per 1000 cubic feet of gas, the average being about 1 gallon per 1000 cubic feet. Knudsen[1] gives the average recovered for 1946 as 1.588 gallons per 1000 cubic feet of gas treated. His figures show the following production:

	M cubic feet natural gas treated	Gallons of gasoline recovered	Recovery gallons per M cubic feet
Oil absorption	405,943,364	644,560,237	1.588

PETROLEUM

Bibliography: State Mineralogist Rept. 4, 7, 10, 12, 13, 29, 31, 33-35 (inc.), 37, 39; Bull. 3, 11, 16, 19, 31, 32, 63, 69, 73, 82, 84, 89, 118. Repts. of Oil and Gas Supervisor 1915 to date (issued in monthly chapters from April 1919 to June 1929, and quarterly from then on). U. S. Geol. Survey Bull. 213, 285, 309, 317, 321, 322, 340, 357, 398, 406, 431, 471, 541, 581, 603, 621, 623, 653, 691; Prof. Papers 116, 117.

The presence of oil seepages and springs in Los Angeles and Ventura Counties was known, and the oil was utilized in a small way early in the history of California. Some also was shipped to refineries at San Francisco from Santa Barbara and Humboldt Counties. In the light of present-day developments, the following reference to the 1865 production of oil and its future prospects as expressed by the San Francisco Bulletin of January 8, 1866, is strikingly prophetic even though skeptical:

[1] Knudsen, E. T., The petroleum situation in the Pacific Coast territory, U. S. Bur. Mines monthly mimeographed report, 1946.

Table 9. Production of crude oil during 1945 and 1946, by county

NOTE: Production figures for counties having only one producing company are combined, to conceal output of individual producers.

County	1945		1946	
	Barrels	Value	Barrels	Value
Fresno	44,370,645	$47,822,774	42,645,954	$53,357,732
Kern	110,290,276	116,846,281	100,640,406	120,353,402
Kings	8,375,249	10,556,594	8,265,449	11,984,901
Los Angeles	85,192,691	89,404,673	87,150,496	106,266,566
Orange	32,214,458	32,988,702	31,859,905	38,428,250
Santa Barbara	23,140,412	19,397,091	22,112,577	23,958,353
Ventura	24,638,277	25,705,785	24,391,381	32,416,978
San Luis Obispo, Santa Clara	40,392	34,867	50,706	45,964
Totals	328,262,400	$342,756,767	317,116,874	$386,812,146

Table 10. Average price per barrel of oil, 1937-46, by county

County	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946
Fresno	$1.255	$1.261	$1.173	$1.068	$0.963	$0.885	$0.998	$1.084	$1.078	$1.251
Kern	.886	.890	.826	.838	.878	0.894	1.015	1.066	1.059	1.196
Kings	1.390	1.390	1.430	1.262	1.217	1.250	1.250	1.130	1.260	1.450
Los Angeles	.968	1.064	1.064	.941	1.008	1.039	1.025	1.081	1.049	1.219
Orange	.945	.956	.952	.900	.901	1.055	0.996	1.027	1.024	1.206
Santa Barbara	1.083	.974	.830	.620	.644	0.709	0.830	0.987	0.838	1.083
Ventura	1.050	1.102	1.090	1.087	1.102	1.129	1.105	1.121	1.043	1.329
State averages	$0.997	$1.038	$1.009	$0.929	$0.953	$0.980	$1.018	$1.061	$1.044	$1.220

Table 11. Annual amount and value of petroleum produced in California, 1865-1946

Estimate of production (barrels) to and including 1886, from Mineral Resources U. S., 1886, p. 440; estimate of values to and including 1886, made after consulting contemporaneous publications including Mining and Scientific Press, Reports of the State Mineralogist, and reports of the U. S. Geological Survey. Figures from 1887 to date compiled from records of the State Division of Mines.

Year	Barrels	Value	Year	Barrels	Value	Year	Barrels	Value
1865			1899	2,677,875	$2,660,793	1924	228,933,471	$274,652,874
(?)-75	175,000	$472,500	1900	4,319,950	4,152,928	1925	232,492,147	330,609,829
1876	12,000	30,000	1901	7,710,315	2,961,102	1926	224,673,281	345,546,677
1877	13,000	29,250	1902	14,356,910	4,692,189	1927	231,195,774	260,735,498
1878	15,227	30,454	1903	24,340,839	7,313,271	1928	231,811,465	229,998,680
1879	19,858	39,716	1904	29,736,003	8,317,809	1929	292,534,221	321,366,863
1880	40,552	60,828	1905	34,275,701	9,007,820	1930	227,328,988	271,699,046
1881	99,862	124,828	1906	32,624,000	9,238,020	1931	188,310,605	141,835,723
1882	128,636	257,272	1907	40,311,171	16,783,943	1932	177,745,286	142,890,247
1883	142,857	285,714	1908	48,306,910	26,566,181	1933	172,139,362	143,063,972
1884	262,000	655,000	1909	58,191,723	32,398,187	1934	174,721,282	159,529,671
1885	325,000	750,750	1910	77,697,568	37,689,542	1935	205,979,855	179,335,311
1886	377,145	870,205	1911	84,648,157	40,552,088	1936	214,776,227	211,667,185
1887	678,572	1,357,144	1912	89,689,250	41,868,344	1937	238,558,562	237,845,872
1888	690,333	1,380,666	1913	98,494,532	48,578,014	1938	249,395,763	258,354,343
1889	303,220	368,048	1914	102,881,907	47,487,109	1939	224,253,110	226,358,856
1890	307,360	384,200	1915	91,146,620	43,503,837	1940	223,294,805	207,479,800
1891	323,600	401,264	1916	90,262,557	57,421,334	1941	229,664,784	218,838,171
1892	385,049	561,333	1917	95,296,309	86,976,209	1942	247,491,289	242,481,545
1893	470,179	608,092	1918	99,731,177	127,459,221	1943	284,145,702	289,323,406
1894	783,078	1,064,521	1919	101,182,962	142,610,563	1944	311,717,804	330,659,802
1895	1,245,339	1,000,235	1920	103,377,361	178,394,937	1945	328,262,400	342,756,767
1896	1,257,780	1,180,793	1921	112,599,860	203,138,225	1946	317,116,874	386,812,146
1897	1,911,569	1,918,269	1922	138,468,222	173,381,265			
1898	2,249,088	2,376,420	1923	262,875,690	242,731,309	Totals	7,313,962,930	$7,365,934,026

"It is possible that the small quantity received (40,000 or 50,000 gallons in 1865) may be the forerunner of many millions which will, at some future time, lubricate the wheels of commerce and set a trade at work excelling in variety any that has thus far been known on this coast. At present, however, we admit to being a little skeptical about the assumption of the astute Professor Silliman that California will be found to have more oil in its soil than all the whales in the Pacific Ocean."

According to Hanks,[2] in 1874 production amounted to 36 barrels per day from natural flows in Pico Cañon (Newhall), and at Sulphur Mountain (Ventura County), the oil being of 32° gravity average.

"Work was commenced in Pico Canyon in 1875 by drilling three shallow wells with spring pole, all of which yielded oil at depths of from 90 to 250 feet. Actual work of development commenced with steam machinery in 1877."[3]

In 1877 Pico averaged 40 to 50 barrels daily, and Ventura 80 barrels daily. In 1878, there was some production (60 barrels per day, for a time) from wells in Moody Gulch, near Los Gatos, Santa Clara County, the oil being of 46° Baumé.

The first wells in the Coalinga, Fresno County, and Summerland, Santa Barbara County, fields were drilled in 1890, but Coalinga did not make its influence felt conspicuously on the state's annual output until 1903. The Summerland yield never has been large. The Salt Lake field near Los Angeles began production in 1894 and in 1897 reached over a million barrels annually.

In the Kern County fields, the first well was drilled in Sunset in 1891, Midway in 1900, McKittrick in 1892, Kern River in 1899. The Sunset-Midway district attained a yield of over 4,000,000 barrels in 1909, and over 20,000,000 barrels in 1910. Kern River field produced over 3,000,000 barrels in 1901.

The first well in the Santa Maria-Lompoc group, Santa Barbara County, was drilled in 1901, and the district advanced to a yield of over 3,000,000 barrels annually in 1905.

The Whittier-Fullerton field in Los Angeles and Orange Counties became an important factor in 1902. The Montebello field, Los Angeles County, was the conspicuous addition in 1918-19; and Elk Hills, Kern County, with Huntington Beach and Richfield, Orange County, in 1920. In 1921, the new fields added were Long Beach and Santa Fe Springs, Los Angeles County. In 1922, Torrance field in Los Angeles County, and Wheeler Ridge field in Kern County were added. Production from the large number of new wells started in the new Los Angeles County fields did not reach its peak until August and September 1923. Dominguez (Compton) came in during 1923, followed by Rosecrans and Inglewood in 1924. Ventura recorded important additions to its producing area in 1925 and 1926. Seal Beach, Orange County, and Mount Poso, Kern County, were the new fields added in 1926; Round Mountain, Kern County, and Rincon, Ventura County, were the new fields added in 1927; and Potrero in Los Angeles County, Elwood in Santa Barbara County, and Kettleman Hills in Kings County were added in 1928.

During 1929 Playa del Rey was added to the oil fields in Los Angeles County, and more recently a number of others have been added in Fresno, Los Angeles, Kern, and Santa Barbara.

New discoveries of petroleum are continually being made in California, but not at a rate fast enough to keep up with demands. Hence, California is now importing some petroleum. Recent discoveries in the Coast area include a deep zone in the Casmalia field, but only one well

[2] Hanks, Henry G., Minerals of California: California Min. Bur. Rept. 4, p. 298, 1884.

[3] Idem, p. 301.

is productive, although others were drilled on the structure. In the Elwood field eight new wells have developed production westward into the tidelands. The West Mountain area in Ventura County now contains five producing wells. Although a number of wells have been drilled previously, this is the first commercial production.

In the Los Angeles Basin two important discoveries have been made recently: one the East Los Angeles field east of the city of Los Angeles; and the other the Alondra Park area in the western part of the Los Angeles Basin. Wells in these areas are 8,000 to 10,000 feet deep, and the fields are still being developed. The discovery at Alondra Park was made in 1946, and a second well was completed in 1947. A new discovery has been made in the Hyperion area, and extensions of existing fields have recently been found at Aliso Canyon and Dominguez. In Orange County two large wells have recently been completed in the midst of old producers: one in the East Coyote field, which is the first flowing well to be completed in many years; the other in the Brea-Olinda field.

An experimental water-flooding project at Richfield oil field has resulted in the recovery of oil attributed to the flooding operation.

In Ventura County, on the Oxnard Plain near Montalvo, a discovery of light-gravity oil containing a high percentage of gasoline was made (1947). This appears to be an important discovery and is being further developed. The State Lands Commission is advertising for bids for oil leases on 1,920 acres at the mouth of the Santa Clara River.

The value of petroleum produced in California each year for many years has been greater than the total value of all other mineral products produced in the state during the same year. Almost as much petroleum is being produced in 1947 as during the peak year of the war. Production was 910,000 barrels per day in May 1947, or 50,000 more barrels per day than in May 1946. Production in 1947 may surpass the all-time high of the year 1945. The increased demand results from new industrial plants, the influx of population to California causing a high demand for gasoline, and high demands of the United States Navy.

Crude petroleum produced in California during 1946 amounted to a total of 317,116,874 barrels, valued at $386,812,146 at the well. The largest value for crude oil for one year in this state was reported in 1946, although in 1945 the amount was exceeded by 11,145,526 barrels. The 1945 output was 328,262,400 barrels, worth $342,756,767. The totals of quantity are compiled from monthly reports filed by operators with the State Oil and Gas Supervisor. Prices paid for crude oil were on April 1, 1946, increased 10 cents a barrel in all fields and on August 1 an additional price increase was granted ranging from 10 to 30 cents per barrel.

The question of the value of crude oil yield at the well is a difficult one to settle with exactitude, principally because a large part of the output is not sold until after refining. The large refiners are also large producers of crude oil, which they send direct from well to plant. Hence much of the crude oil is not sold as such.

The value used in the statistical reports of the State Mining Bureau and the Division of Mines from 1914-27 inclusive, was derived from an average of actual sales of crude oil of all grades in each field of the state and their average applied to the total yield of each respective field. The 1929-33 values used by the Division of Mines were obtained by using the production of crude oil by gravities produced in each field and applying

an average of current price quotations for crude oil at the well as compiled by California Oil and Gas Association.

The values given to the 1934-46 petroleum output by this department were obtained by using the average gravity oil for each field, to which was applied the average quotation for the year of said grade oil.

All counties showed an increase in the total value of crude oil output, but Los Angeles County was the only major petroleum-producing county that showed an increase in the number of barrels produced. Kern County led all others, passing Los Angeles County, which outranked Kern from 1923-43 inclusive.

Table 10 shows an average price of $1.22 per barrel for petroleum at the well in California during the year 1946, as compared with $1.044 in 1945, $1.061 in 1944, $1.018 in 1943, $0.980 in 1942, $0.953 in 1941, $0.929 in 1940, $1.009 in 1939, $1.038 in 1938, $0.997 in 1937, and $0.986 in 1936.

Table 11 gives the total number of barrels and their value by years of California's petroleum output.

Specific Gravity of Oils Produced

The proportion of heavy and light oil produced in the various fields is shown in table 12, contributed by the Standard Oil Company. Specific gravities in California range from 8° Baumé in the Casmalia field, Santa Barbara County, to 65° in Helm field, Fresno County.

California crude oils are all essentially of asphalt base, with a few notable exceptions. In the following localities are wells yielding crudes containing both asphalt and paraffine constituents: Oil City field, Coalinga; a few deep wells in East Side field, Coalinga; a considerable part of the Ventura County field; Western Minerals area, south of Maricopa; and Wheeler Ridge, Kern County.

Oil in "Storage"

Field, refinery, pipe-line and tank-farm stocks of crude and refined products in the Pacific Coast[4] territory totaled 86,447,728 barrels on December 31, 1946, as compared with 71,285,295 barrels on December 31, 1945, total increase in stock from the preceding year being 15,162,433 barrels. Table 13 gives a breakdown of stocks as of December 31, 1945 compared with December 31, 1946.

Utilization of California Crude Oil

Most of the crude oil produced in California is sent to storage reservoirs at tank farms near the oil fields and from these reservoirs by pipe lines to the refineries, the larger ones of which are located in the vicinity of Los Angeles and on San Francisco Bay.

Crude oil consumed in California during 1946 according to the U. S. Bureau of Mines[5] was: 283,522,000 barrels sent to stills at the refineries; 3,535,000 barrels used for cracking; 22,657,000 barrels either consumed as fuel or added to residuum; and 5,154,000 barrels shipped outside of the state. In 1946 stocks were increased by 4,630,000 barrels over those of 1945. For comparison the following figures for 1945 are given: 307,483,000 barrels sent to stills; 7,681,000 barrels used for cracking; 18,944,000 barrels either used as fuel or added to residuum; 3,906,000 barrels shipped outside of the state; and stocks were depleted by 2,193,000 barrels from the previous year.

[4] American Petroleum Institute, Summary of California Oilfield Operation for December 1946.

[5] Knudsen, E. T., op. cit.

Operating Data

Table 16 is compiled from data published semiannually by the State Division of Oil and Gas.[6] These data have been combined to show the operations in all fields during the entire year. The districts are the geographical subdivisions as administered by the Division of Oil and Gas and are outlined on the map accompanying their report.

Proved Oil Land

The total proved oil land and natural-gas land in California as of December 31, 1946 was 254,089 acres, an increase of 7,470 acres during

[6] Summary of operations, California oil fields: California Div. Oil and Gas, 32d Ann. Rept., no. 1, 70 pp., 1946... no. 2, 150 pp., 1946.

Table 12. Production of light and heavy oils, by fields, for 1946

Field	Under 20° (barrels)	20° and above (barrels)	Total (barrels)
SAN JOAQUIN VALLEY			
Ant Hills	397,811	105,221	503,032
Antelope Hills	575,083	----------	575,083
Arvin	----------	8,292	8,292
Bellevue	----------	135,111	135,111
Belridge, North	13,768	1,940,668	1,954,436
Belridge, South	3,850,453	61,878	3,912,331
Blackwells Corner	79,732	----------	79,732
Brundage	11,094	----------	11,094
Buena Vista	----------	14,758,100	14,758,100
Burrel	----------	4,393	4,393
Canal	----------	866,252	866,252
Canfield Ranch	----------	10,998	10,998
Chico Martinez	4,518	----------	4,518
Coalinga, East	893,990	5,360,117	6,254,107
Coalinga, West	2,522,275	30,081	2,552,356
Coalinga Nose and Northeast	----------	20,423,718	20,423,718
Colcs Levee, North	----------	5,676,296	5,676,296
Coles Levee, South	----------	658,408	658,408
Cymric	478,785	2,654,909	3,133,694
Devils Den	1,298	931	2,229
Edison	3,939,508	1,327,444	5,266,952
Elk Hills	467,754	3,191,759	3,659,513
Fruitvale	2,548,151	187,749	2,735,900
Gosford	----------	29,726	29,726
Greeley	----------	3,884,167	3,884,167
Helm	----------	1,573,336	1,573,336
Jacalitos	----------	1,597,106	1,597,106
Jasmin	850	----------	850
Kern Front	3,291,543	----------	3,291,543
Kern River	3,613,214	----------	3,613,214
Kettleman Hills	----------	13,846,841	13,846,841
Lanare	----------	795,413	795,413
Lost Hills	818,365	501,102	1,319,467
McClung	----------	13,564	13,564
McDonald Anticline	16,537	----------	16,537
McKittrick	1,700,390	----------	1,700,390
Midway-Sunset	9,915,351	5,493,324	15,408,675
Mountain View	15,780	1,402,881	1,418,661
Mount Poso	5,960,630	----------	5,960,630
Paloma	----------	2,163,130	2,163,130
Pleasant Valley	----------	1,308,131	1,308,131
Poso Creek	1,260,906	----------	1,260,906
Pyramid Hills	118,264	----------	118,264
Race Track Hill	----------	509,114	509,114
Raisin City	23,500	996,019	1,019,519
Rio Bravo	----------	4,806,770	4,806,770
Riverdale	----------	1,481,237	1,481,237
Rosedale Ranch	----------	45,356	45,356
Round Mountain—Coffee Canyon	3,079,234	277,504	3,356,738
Salt Creek	390,748	59,802	450,550
Sheep Springs	6,235	164,003	170,238
Strand	----------	856,922	856,922
Tejon	506,833	----------	506,833
Ten Section	----------	3,229,396	3,229,396
Union Avenue	138,858	----------	138,858
Wasco	----------	270,391	270,391
Wheeler Ridge	----------	83,646	83,646
COASTAL			
Aliso Canyon	14,532	1,084,874	1,099,406
Arroyo Grande	14,345	----------	14,345
Capitan	----------	1,265,653	1,265,653
Casmalia	105,764	5,000	110,764
Cat Canyon	2,832,797	112,300	2,945,097
Del Valle	14,860	2,339,732	2,354,592
Elwood	----------	2,450,991	2,450,991
Gato Ridge	1,419,249	----------	1,419,249
Lompoc	437,200	100,244	537,444
Newhall	----------	26,766	26,766
Newhall-Potrero	----------	2,117,309	2,117,309
Oak Canyon	----------	639,546	639,546
Oat Mountain	7,543	----------	7,543
Orcutt	----------	1,309,143	1,309,143
Padre Canyon	----------	894,051	894,051
Rincon	----------	1,628,336	1,628,336
San Miguelito	----------	1,845,283	1,845,283
Santa Barbara	31,642	----------	31,642
Santa Maria Valley	11,921,467	----------	11,921,467
Summerland	924	----------	924
Ventura Avenue	----------	16,914,375	16,914,375
Ventura County	412,058	2,468,313	2,880,371
Watsonville	5,765	----------	5,675
Zaca Creek	115,005	----------	115,005
SOUTHERN CALIFORNIA			
Alondra	----------	72,137	72,137
Brea-Olinda	420,862	3,527,039	3,947,901
Buena Park	----------	23,891	23,891
Coyote, East	170,262	1,584,385	1,754,647
Coyote, West	----------	5,575,722	5,575,722
Dominguez	----------	5,867,064	5,867,064
East Los Angeles	----------	178,836	178,836
El Segundo	71,078	127,405	198,483
Huntington Beach	1,819,878	15,275,119	17,094,997
Inglewood	517,294	4,202,476	4,719,770
La Mirada	----------	21,428	21,428
Lawndale	----------	6,974	6,974
Leffingwell	----------	7,253	7,253
Long Beach	150,138	8,950,230	9,100,368
Los Angeles	58,891	----------	58,891
Montebello	4,453	3,127,941	3,132,394
Newport	1,636,306	277,918	1,914,224
North El Segundo	30,222	----------	30,222
North Whittier Heights	5,205	----------	5,205
Playa del Rey	60,395	802,124	862,519
Potrero	----------	333,736	333,736
Richfield	845,089	1,865,665	2,710,754
Rosecrans	----------	1,847,055	1,847,055
Salt Lake	100,003	----------	100,003
Santa Fe Springs	----------	6,113,737	6,113,737
Seal Beach	----------	3,695,261	3,695,261
Torrance	2,115,444	1,022,946	3,138,390
Turnbull Canyon	----------	46,041	46,041
Whittier	283,917	118,933	402,850
Wilmington	9,933,455	30,260,450	40,193,905
Totals	82,197,501	232,924,888	315,122,389

the year 1946, according to data furnished by the Division of Oil and Gas.[7] The acreage as of December 31, 1945 and December 31, 1946 by counties, is given in table 15.

[7] Summary of operations, California oil fields: California Div. Oil and Gas, 32d Ann. Rept., no. 2, 150 pp., 1946.

Table 13. Comparison of stocks of crude and refined products, 1945 and 1946

(From American Petroleum Institute, Summary of California Oilfield Operations for December 1946.)

Commodity	December 31, 1945 (barrels)	December 31, 1946 (barrels)
Gasoline-bearing crude	18,721,076	22,205,421
Non-gasoline-bearing crude	4,488,510	5,747,612
Unblended natural gasoline, L. P. G. and cycle condensate	1,043,383	1,087,318
Gasoline (except distributing and service stations)	12,670,064	13,761,181
Naphtha distillates (including estimated unfinished gasoline)	3,141,768	3,334,557
Gas oil and diesel oil	8,044,746	12,434,029
Fuel oil residuum	18,103,572	22,410,753
All other stocks (including coke)	5,067,176	5,466,857
Totals	71,285,295	86,447,728
Estimated unfinished gasoline contained in naphtha distillates	2,612,412	2,775,844
Coke included in all other stocks	382,409	230,266

Table 14. Output of petroleum products during 1945 and 1946

(After E. T. Knudsen, U. S. Bureau of Mines)

Commodity	Barrels (1945)	Barrels (1946)
Crude petroleum to stills	307,483,000	283,522,000
Crude petroleum used for cracking	7,681,000	3,535,000
Natural-gas gasoline	15,554,000	15,348,000
Gasoline and naphtha distillates	119,297,000	110,456,000
Kerosene and kerosene distillates	4,277,000	4,849,000
Lubricating oils and greases	3,778,000	3,758,000
Gas oil and diesel oil	37,956,000	49,867,000
Fuel oil, residuum, and non-gasoline crude (including heavy non-gasoline crude oil)	137,789,000	109,452,000
Asphalt and road oil	8,709,000	8,959,000
Total (crude oil and natural gasoline)	330,718,000	302,405,000
Heavy non-gasoline crude oil included with fuel oil, residuum, and non-gasoline crude, above	18,944,000	22,657,000

Table 15. Proved oil and natural-gas acreage in California in 1945 and 1946

County	Acres Dec. 31, 1945	Acres Dec. 31, 1946	County	Acres Dec. 31, 1945	Acres Dec. 31, 1946
Butte	20	40	San Joaquin	2,495	2,395
Colusa	20		San Luis Obispo	300	255
Contra Costa	953	953	Santa Barbara	18,336	16,052
Fresno	33,049	33,674	Santa Clara	90	90
Glenn	270	270	Solano	9,528	10,548
Humboldt	480	480	Sonoma	20	20
Imperial (carbon-dioxide gas only)	135	230	Stanislaus	50	50
Kern	114,790	119,025	Sutter	840	840
Kings	8,468	9,348	Tehama	20	120
Los Angeles	21,007	21,581	Tulare	5,000	7,080
Madera	905	905	Ventura	8,040	7,855
Orange	8,279	8,489	Yolo	240	280
Sacramento	13,284	13,509	Totals	246,619	254,089

Table 16. Production statistics and operating data of California oil fields, 1946

Field	January 1 to June 30				July 1 to December 31				Cumulative production of oil (bbls.) to end 1946	Proved acreage as of Dec. 31, 1946
	Average number of producing wells—actual	Oil (bbls.)	Production per well per day (bbls.)	Percentage of time wells produced	Average number of producing wells—actual	Oil (bbls.)	Production per well per day (bbls.)	Percentage of time wells produced		
DIST. 1—Aliso Canyon	33	530,368	116.1	76.5	36	567,591	103.4	82.9	6,530,362	505
Beverly Hills	2	18,716	54.6	94.8	2	18,713	53.8	94.6	[13]3,974,060	15
Brea-Olinda	344	1,922,376	32.5	95.0	353	2,026,242	32.6	95.6	189,142,546	1,398
Coyote, East	171	914,528	31.2	94.7	171	911,426	30.3	95.6	55,903,653	1,170
Coyote, West	198	2,809,025	82.9	94.6	201	2,766,742	78.2	95.6	148,932,508	948
Del Valle	55	1,086,542	113.1	96.5	58	1,021,753	99.5	96.3	7,797,852	595
Dominguez	315	3,022,319	54.2	97.7	321	2,841,741	49.4	97.4	168,231,003	1,235
El Segundo	29	96,935	19.4	95.1	31	100,358	18.4	95.4	11,745,030	350
Huntington Beach	844	8,464,982	58.0	95.6	871	8,620,983	55.9	96.2	377,825,164	3,270
Inglewood	305	2,432,106	46.1	95.6	303	2,292,172	42.8	96.0	156,794,878	850
Lawndale	2	3,245	9.7	92.3	3	3,371	7.0	87.3	[11]1,149,529	15
Long Beach	1,125	4,592,807	23.3	96.6	1,116	4,451,570	22.5	96.5	[17]15,596,421	1,163
Los Angeles City	90	41,585	2.7	96.3	86	34,670	2.3	95.1	[12]0,062,919	250
Montebello	342	1,630,544	27.4	96.2	342	1,495,809	24.5	96.7	145,749,899	1,385
Newhall	15	16,416	6.7	90.8	14	16,578	7.6	85.0	5,967,821	375
Newhall-Potrero	39	1,022,317	152.6	94.9	42	1,088,629	147.9	95.2	11,579,252	620
Newport, West	65	695,788	62.6	94.5	102	1,179,877	67.8	92.7	2,241,512	573
Newport, West	*1				*1					
Oak Canyon	17	332,408	117.0	92.3	16	310,283	119.8	87.9	2,286,044	230
Playa del Rey	118	430,239	20.8	96.7	117	416,782	19.9	97.3	50,657,893	475
Potrero	24	184,312	46.1	92.0	24	150,793	36.2	94.2	5,887,185	150
Richfield	320	1,318,694	23.4	97.3	315	1,307,329	23.2	97.2	108,110,615	1,260
Rosecrans	182	931,228	29.3	96.4	182	905,484	27.8	97.1	59,612,782	740
Salt Lake	6	29,392	28.9	93.6	5	26,160	29.2	97.5	[14]2,937,988	15
Santa Fe Springs	546	3,049,916	31.6	97.5	543	3,054,147	31.6	96.6	511,924,311	995
Seal Beach	159	1,791,114	65.9	95.4	167	1,895,698	64.9	95.1	105,565,202	525
Torrance	713	1,591,847	12.9	95.4	711	1,567,110	12.5	95.9	[11]18,457,451	4,888
Turnbull	5	23,888	26.4	99.9	5	22,153	24.1	99.9	432,371	65
Whittier	164	203,972	7.0	98.6	161	199,540	7.1	93.9	20,939,222	600
Wilmington	1,491	18,418,641	70.8	96.4	1,579	21,757,352	77.5	96.7	321,774,184	5,240
Los Angeles County:										
Alondra area	1	13,472	109.5	68.0	1	72,107	558.9	70.1	72,107	10
Buena Park area	1	3,498	39.3	49.2	1	6,026	45.0	72.8	20,329	10
East Dominguez area	2	62,326	228.3	75.4	1	5,720	33.5	92.9	9,218	10
East Los Angeles area	1	5,844	32.5	99.4	4	116,510	185.5	85.3	179,204	40
Hyperion area	1	2,497	19.8	69.6	2	24,238	76.9	85.6	49,611	20
Leffingwell area	1	876	28.3	17.1	1	5,016	46.9	58.2	7,513	10
Ramona area	1	161	11.5	7.7	1	730	9.1	43.5	1,606	10
Simi area	1	1,361	8.7	86.7	2	718	4.6	42.1	1,384	10

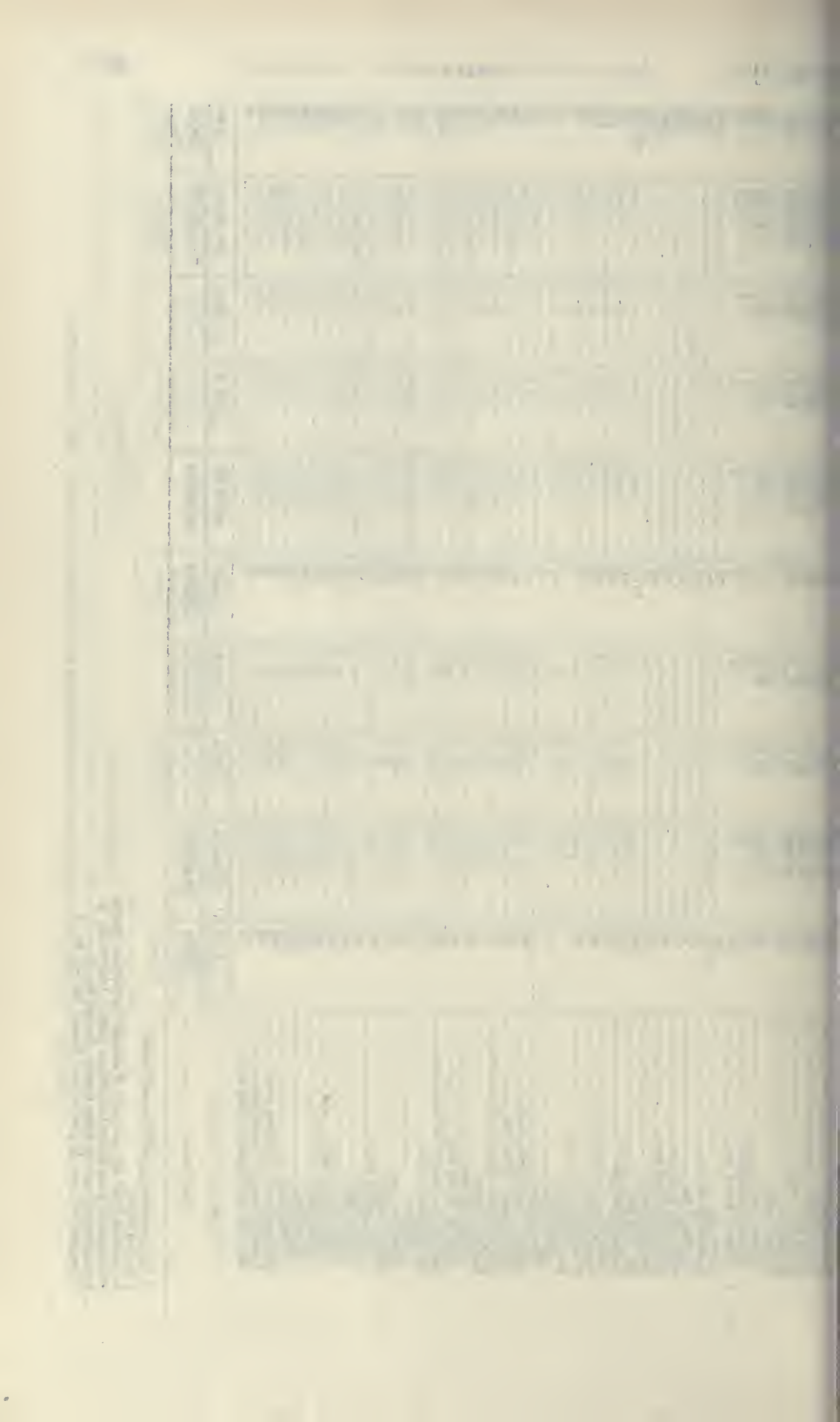
Western Avenue area	3	2,700	7.1	70.3	1	1,119	6.2	98.4	36,426	10
Whittier Heights area					3	2,435	5.6	78.3	15,719	20
Orange County: Buena Park area	2	13,935	39.9	96.4	2	11,806	33.1	97.0	186,691	20
Totals	7,733	57,712,920	42.9	96.0	7,896	61,297,481	43.9	96.1	3,378,389,465	30,070
Imperial carbon dioxide gas	17				19					230
DIST. 2—Bardsdale	180	337,564	11.2	92.3	178	285,037	9.5	91.8	16,772,182	1,050
Ojai	68	23,685	2.3	83.9	66	21,393	2.0	86.0	3,366,673	420
Oxnard	5	194,121	266.6	80.4	5	155,099	214.2	78.7	1,860,676	180
Piru	96	215,364	14.1	88.1	103	421,011	25.8	86.0	10,369,821	665
Rincon	168	2,176,471	79.4	90.1	172	2,190,230	76.8	90.1	40,259,946	1,240
Santa Paula	28	10,171	3.8	52.3	27	8,638	3.7	47.5	2,292,038	150
Sespe	26	49,480	14.3	73.5	25	56,506	17.0	72.4	3,367,634	230
Simi	54	12,846	1.4	96.8	52	12,402	1.4	89.6	2,286,769	505
South Mountain	117	580,786	29.5	92.9	125	731,560	33.4	95.2	26,319,381	920
Ventura	504	8,401,180	103.3	89.2	535	8,507,837	97.8	88.3	319,912,778	2,495
Totals	1,246	12,001,668	59.9	88.9	1,288	12,389,713	59.2	88.3	426,807,898	7,855
DIST. 3—Arroyo Grande	16	27,943	11.1	86.3	15	20,233	9.3	79.1	1,387,160	190
Capitan	62	632,307	59.2	95.2	66	633,083	54.4	95.8	10,815,865	260
Casmalia	8	41,212	73.9	38.5	10	69,113	64.0	58.7	15,240,288	930
Cat Canyon	104	2,165,866	125.1	92.0	114	2,219,810	120.2	88.1	43,484,352	2,640
Elwood	67	1,155,094	99.8	95.4	71	1,299,058	105.7	94.1	77,679,033	600
La Goleta gas	*8				*9				283	340
Lompoc	30	255,864	48.4	97.4	32	281,451	49.5	96.6	12,943,252	1,530
Mesa	16	17,628	6.6	96.0	15	14,542	6.2	85.0	3,548,243	22
Moody Gulch	0	0	0	0	0	0	0	0	60,589	10
Santa Maria	200	648,304	18.4	97.2	203	660,120	18.4	95.8	104,198,000	3,540
Santa Maria Valley	426	6,191,556	85.7	93.8	444	5,711,241	73.8	94.7	74,791,377	6,100
Sargent	8	2,530	2.5	70.9	0	0	0	0	783,759	80
Summerland	1	714	6.2	63.5	1	630	3.8	91.3	3,181,301	10
Santa Barbara County: Zaca area	2	55,717	196.2	78.5	2	59,267	204.4	78.8	182,335	80
Totals	940	11,194,735	70.2	93.8	973	10,968,548	65.6	93.5	348,295,837	16,332
DIST. 4—Antelope Hills	27	295,545	68.8	87.9	27	279,539	69.0	81.6	2,789,579	245
Ant Hill	26	236,496	53.7	93.6	31	264,349	48.0	96.6	735,263	305
Belridge, North	66	1,021,052	95.0	89.9	71	937,099	80.2	89.4	53,084,042	1,825
Belridge, South	720	1,979,966	16.2	93.7	724	1,926,006	15.2	95.4	[2]40,439,426	5,815
Blackwells Corner	22	37,362	10.0	93.3	25	43,744	9.9	96.2	180,305	190
Canal	33	508,459	102.8	82.8	31	360,652	80.2	78.8	12,493,074	780
Canfield Ranch	3	21,704	52.8	75.7	3	19,020	38.5	89.5	235,979	50
Coles Levee, North	82	2,744,767	192.4	96.1	87	2,931,529	193.3	94.7	31,369,899	3,030
Coles Levee, North	*2				*2					
Coles Levee, South	46	978,295	139.2	84.4	40	723,236	140.6	69.9	10,021,450	3,070
Coles Levee, South	*3				*2					
Devils Den	4	4,956	8.2	83.8	2	4,713	16.0	79.9	112,060	140
Edison	227	2,822,646	79.7	86.2	264	3,004,558	70.2	88.0	19,850,582	2,590
Elk Hills	216	2,231,178	78.8	72.4	155	1,436,554	79.8	63.1	193,993,690	13,730
Elk Hills	*3				*3					

Table 16. Production statistics and operating data of California oil fields, 1946—Continued

Field	January 1 to June 30				July 1 to December 31				Cumulative production of oil (bbls.) to end 1946	Proved acreage as of Dec. 31, 1946
	Average number of producing wells—actual	Oil (bbls.)	Production per well per day (bbls.)	Percentage of time wells produced	Average number of producing wells—actual	Oil (bbls.)	Production per well per day (bbls.)	Percentage of time wells produced		
Fruitvale	193	1,444,523	46.2	89.6	189	1,420,795	45.2	90.3	38,877,014	1,940
Greeley	97	1,964,499	139.6	80.1	98	1,958,238	133.6	81.3	28,073,582	1,970
Kern Front	591	1,592,792	15.4	96.4	603	1,635,584	15.4	95.8	62,472,264	4,040
Kern River	2,224	1,804,069	4.6	96.5	2,222	1,788,039	4.5	96.2	[2]292,148,433	7,160
Lost Hills	392	644,219	9.5	95.6	405	670,885	9.5	94.6	57,870,277	2,625
McKittrick, Cymric area	235	562,350	13.4	98.7	218	2,706,711	73.8	91.4	[2]11,478,650	1,825
McKittrick-Temblor	149	1,586,171	64.7	90.9	237	561,936	13.2	97.8	93,832,272	1,180
Midway-Sunset	3,756	14,844,264	22.9	95.2	3,751	15,245,131	23.1	95.6	[2]1,033,305,606	[3]42,945
Midway-Sunset	17				*15					
Mount Poso	501	3,073,878	35.2	96.2	507	2,861,759	31.5	97.3	91,522,276	2,965
Mountain View	132	564,416	25.5	92.7	135	792,315	34.3	93.1	47,335,638	1,750
Paloma	37	1,544,045	268.8	85.8	47	1,872,851	240.4	90.0	8,057,764	4,720
Paloma					*1					
Poso Creek	194	672,156	20.3	94.1	196	642,622	19.1	43.3	[2]10,741,882	1,835
Rio Bravo	96	2,472,424	148.1	96.1	88	2,411,623	154.8	96.2	38,311,776	1,870
Round Mountain	322	1,709,323	30.4	96.3	330	1,641,687	28.0	96.6	50,082,851	2,285
Strand	23	432,306	123.0	84.4	22	424,614	112.1	93.6	4,844,073	380
Tejon	31	162,400	32.7	88.5	49	326,841	39.8	91.0	813,256	770
Ten Section	117	1,601,999	93.9	80.5	116	1,627,396	93.5	81.5	38,902,596	1,880
Wasco	9	151,831	109.3	85.3	8	118,082	92.2	87.0	4,550,432	200
Wheeler Ridge	34	41,545	6.9	98.0	34	41,000	6.7	97.4	4,396,704	230
Kern County:										
Bellevue area	3	74,800	158.8	86.7	3	56,605	140.4	73.0	485,579	60
Chico Martinez area	3	3,405	9.4	66.8	3	1,935	7.9	44.4	45,770	30
Jasmine area					1	1,836	37.5	26.6	2,991	0
McDonald Anticline area	4	8,512	15.6	75.4	5	8,476	11.7	78.7	21,320	20
McClung area	1	5,182	28.9	98.9	1	3,555	22.8	84.8	99,008	10
Rosedale Ranch area	4	20,409	33.4	84.2	4	24,947	35.7	94.8	78,768	80
Bowerbank gas	*2				*1					1,360
Buttonwillow gas	*10				*8					790
Semitropic gas	*8				*6					1,600
Trico gas	*16				*20					[4]8,760
Totals	10,620	49,863,944	27.5	94.2	10,732	50,776,462	27.2	94.4	2,283,656,136	127,050
Dist. 5—Coalinga	1,342	4,471,131	19.3	95.6	1,336	4,304,975	18.3	95.7	[1]413,964,116	15,782
East Coalinga Extension	201	10,014,760	288.0	95.6	198	10,398,080	300.1	95.1	118,599,423	4,160
Helm	76	1,120,141	94.3	86.3	90	1,244,618	82.9	90.7	4,586,993	4,395
Jacalitos	58	837,351	84.1	94.8	62	785,258	74.2	92.8	5,352,643	1,460
Kettleman Middle Dome	0	0	0	0	0	0	0	0	552,036	0
Kettleman North Dome	294	6,930,480	141.6	92.0	296	6,918,486	136.9	92.8	324,178,496	13,075

Pleasant Valley	22	667,115	177.6	94.3	23	634,657	172.1	87.1	3,784,556	480
Pyramid Hills	22	57,352	15.0	96.3	22	53,578	13.9	95.0	320,108	130
Raisin City	34	468,129	81.8	92.9	37	519,439	82.4	92.6	3,825,257	965
Riverdale	52	686,003	79.4	91.8	59	795,458	80.9	90.5	5,247,449	1,630
Fresno County:										
Burrel area	1	2,352	13.1	99.4	1	2,040	11.1	100.0	29,514	20
Cantua Creek area	0	0	0	0	0	0	0	0	3,146	10
Cheney Ranch area	0	0	0	0	0	0	0	0	4,798	10
Eureka gas	*3				*3					480
Fairfield Knolls gas	*1				*1					240
Gill Ranch gas	*7				*3					810
Marysville Butte gas	*5				*5					840
McDonald Island gas	*5				*5					1,060
Ord Bend gas	*3				*3					210
Rio Vista gas	*106				*117					[5]21,750
Roberts Island gas	*1				*1					20
Tracy gas	*2				*2					175
Vernalis gas	*2				*2					100
Willows gas	*0				*0					20
Butte County:										
Chico area					*1					20
Durham area					*1					20
Colusa County: Colusa area	*0				*0					0
Glenn County: Afton area	*0				*0					40
Kings County: Trico Northwest area	*0				*0					20
Madera County:										
Chowchilla area	*0				*0					80
Moffatt Ranch area	*1				*1					20
Sacramento County: Thornton area	*0				*1					1,780
San Joaquin County:										
Lodi area	*0				*3					580
Thornton area	*0				*1					510
Solano County:										
Cache Slough area	*1				*1					260
Honker area	*1				*1					20
Kirby Hill	*2				*2					270
Maine Prairie area	*1				*1					690
Millar area	*1				*1					160
Suisun area	*1				*1					40
Winters area	*1				*1					40
Sonoma County: Petaluma area	*0				*0				3,304	20
Tehama County: Corning area	*0				*0					120
Yolo County: Dunnigan Hills area	*0				*0					40
Totals	2,102	25,254,814	70.2	94.6	2,124	25,656,589	69.4	94.6	880,451,839	72,552
Grand totals	22,641	156,028,081			23,013	161,088,793			7,317,601,175	253,859

* Dry gas wells omitted from well totals.
[1] Revised figure.
[2] Corrected figure due to receipt of amended production reports.
[3] Includes 65 acres in San Luis Obispo County, District No. 3.
[4] Includes 880 acres in Kings County, District No. 5.
[5] Includes 953 acres in Contra Costa County, District No. 3.



CHAPTER TWO

METALS

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INTRODUCTION

Bibliography: State Mineralogist Rept. 1-42 (inc.) ; Bull. 5, 6, 18, 23, 27, 36, 50, 57, 76, 78, 85, 92, 95, 108, 125, 129, 130, 134, 135.

The value of metals produced in California during 1946 amounted to $23,895,665, as compared with $16,928,007 in 1945. Increases in total values over 1945 were reported for gold, lead, iron ore, molybdenum ore, platinum-group metals, silver, titanium minerals, and tungsten ore. Gold leads all metals in value of total output for the year. It has held this position as far back as records of production have been kept in California, with the exception of 1943, when its value was exceeded by quicksilver and tungsten ore, and 1944 when it was passed by tungsten ore only.

Table 17. Comparison of 1945 and 1946 output of metals in California

NOTE: Where no figures are given under "Value" and "Amount" for a metal listed under "Substance", the metal was produced during the year; but the production figures have been combined with others under "Unapportioned" to conceal output of individual producers.

Substance	1945		1946		Value of increase (+) or decrease (—)
	Amount	Value	Amount	Value	
Chromite	9,784 long tons	$431,445			(—)
Copper	13,949,675 lbs.	1,883,206	8,337,352 lbs.	$1,357,131	$526,075—
Gold	147,938 fine ozs.	5,177,830	356,824 fine ozs.	12,488,840	7,311,010+
Iron ore	240,917 tons	883,434	428,354 tons	1,061,956	178,522+
Lead	14,504,767 lbs.	1,247,410	20,432,630 lbs.	2,227,157	979,747+
Manganese ore	1,875 long tons	86,270	No production	No prod.	86,270—
Molybdenum ore	No production	No prod.			(+)
Platinum group metals	145 fine ozs.	6,719			(+)
Quicksilver	21,062 flasks	2,697,835	17,804 flasks	1,648,758	1,049,077—
Silver	986,798 fine ozs.	701,723	1,342,651 fine ozs.	1,084,862	383,139+
Titanium	No production	No prod.			(+)
Tungsten ore	71,511 units	1,587,951	102,513 units	2,072,680	484,729+
Zinc	19,340,732 lbs.	2,224,184	14,639,804 lbs.	1,786,056	438,128—
Unapportioned (includes chromite, molybdenum ore, platinum-group metals, titanium; 1946 only)				168,225	168,225+
Total values		$16,928,007		$23,895,665	
Net increase					$6,967,658+

ALUMINUM

Bibliography: State Mineralogist Rept. 18, p. 198, 37; Bull. 38, 67, 130.

Though the high-grade clays of the Eocene of California occur in enormous quantity, the alumina content is too low to induce prospective companies to attempt operating on the basis of making aluminum from them.

Raw material for aluminum production in California has been imported from other states because commercial deposits of the ore, bauxite, have not yet been found in California.

During the war aluminum was produced in two large plants in California, owned by the United States Government, one at Riverbank and the other at Los Angeles (Torrance). The possibility exists that these plants will be reopened by private capital, providing power can be obtained at a rate low enough to make the operation economic. Demand for aluminum for building and other purposes continues to be high.

ANTIMONY

Bibliography: State Mineralogist Rept. 8, 10, 12-15 (inc.), 17, 22, 23, 25, 26, 27, 31, 34, 36; Bull. 38, 91, 130.

Known deposits of antimony in California are small; ores occur in Inyo, Kern, Orange, San Benito, and San Bernardino Counties, where small amounts have been produced occasionally.

During 1946 no shipments of antimony ore were reported from California sources. The last production reported was in 1944 and came from two properties, one in Kern and one in Inyo County.

Antimony is used as an alloy with lead in metal bearings, storage batteries, type metal, cable covering, collapsible tubes, ammunition, and solder. Sheets, pipe, and castings of this alloy are made also. In nonmetallic products, antimony is used for flameproofed textiles, paints, ceramic enamels, glass, pottery, ammunition primers, matches, and various chemicals.

Table 18. Annual tonnage and value of antimony produced in California, 1887-1946

(Tonnage figures 1889-1939, inclusive, represent tons of antimony ore shipped; 1940-46, amount of recoverable metal.) NOTE: Where necessary in order to conceal output of individual producers, production figures are omitted, or combined to cover a 2-year period.

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1887	75	$15,500	1900	70	$5,700	1939	150	$4,552
1888	100	20,000	1901	50	8,350	1940	28	7,958
1889	0	0	1902	510	35,666	1941	10	2,537
1893	50	2,250	1916	1,015	64,793	1942	30	9,251
1894	150	6,000	1917	158	18,786	1943	0	0
1895	33	1,485	1918	0	0	1944		
1896	17	2,320	1925-26	26	770	1945	0	0
1897	20	3,500	1927	20	590	1946	0	0
1898	40	1,200	1928	20	761			
1899	75	13,500	1929	0	0	Totals	2,647	$225,469

Antimony ores and concentrates are marketed upon a base of minimum antimony content with penalties for impurities, if present. The principal western buyer of antimony ores is the National Lead Company, Texas Mining and Smelting Division, Laredo, Texas. The price schedule per short ton unit of 20 pounds of contained antimony of this firm as of October 15, 1947, is as follows (all quotations car lots f.o.b. Laredo, Texas): 60 percent ore, $3.37; 55 percent ore, $3.32; 50 percent ore, $3.25; 45 percent ore, $3.18; 40 percent ore, $3.11; 35 percent ore, $3.04; and 30 percent ore, $2.84. Arsenic, copper, lead (under certain conditions), and selenium are undesirable impurities; such combined impurities cannot exceed 0.5 percent and avoid penalty. Representative samples of lots of ore should be sent for analysis and quotation of prices, premiums and penalties; and no shipments should be made until this is done and the buyer authorizes shipment on quoted conditions of sale.

Buyers of antimony ore in California are Harshaw Chemical Company, El Segundo, and Morris P. Kirk & Son, 2717 South Indiana Street, Los Angeles. The approximate present purchase basis upon which antimony ores and concentrates are bought f.o.b. El Segundo by Harshaw Chemical Company is as follows:

The base is 50 percent antimony, paid for at $4.00 per unit, with penalties and premiums below and above 50 percent, of one cent per unit. No ore or concentrates accepted containing less than 40 percent antimony. A moisture charge of 50 cents per unit of moisture over 10 percent is made.

Allowable arsenic and lead is 0.2 percent each. Arsenic over 0.2 percent is penalized at $12.00 per unit. Lead over 0.2 percent is not accepted except by special contractual arrangement. A smelting charge of $25.00 per ton is made against the gross payments noted above. No shipments should be made until contractual arrangements based on analyses of samples and other factors are completed and authorization to ship obtained from the company.

ARSENIC

Bibliography: State Mineralogist Rept. 18, 23, 25, 30, 33, 35; Bull. 67, 130. Mineral Resources U. S.: U. S. Geol. Survey, annual publication, see under each metal.

Arsenic is found in a number of localities in California in the mineral arsenopyrite (FeAsS), which is frequently gold bearing; and in scorodite ($FeAsO_4+2H_2O$), an oxidation product of arsenopyrite. The occurrence of realgar (AsS) has also been noted.

Except for a small output in 1924, there has been no commercial recovery of arsenic from California ores.

BERYLLIUM

Bibliography: State Mineralogist Rept. 27, 35, 36. U. S. Bur. Mines Inf. Circ. 6190.

Beryl occurs in California in the pegmatite dikes of the tourmaline gem district in northern San Diego and southwestern Riverside Counties. An occurrence has recently been noted in western Inyo County, but the quantity is as yet unproved. Thus far there has been no commercial shipment of beryl from California except for gem purposes (the pink and aquamarine varieties).

There are a number of beryllium minerals, but none have been found in commercial quantities, except beryl, which is beryllium-aluminum silicate. The chief use at present for ground beryl is as an addition to porcelain products, where it reduces the coefficient of expansion.

Beryllium is a metal resembling aluminum closely in its chemical character, and is difficult to separate from aluminum. It has a specific gravity of 1.85, is almost as hard as quartz (will scratch glass) and will take a high polish. The uses of beryllium in fabricated products include beryllium-copper rod available in diameters up to 3 inches, and wire drawn to a minimum 10/1000 inch; also drawn tubing. A new development is the use of beryllium-copper in cast-setting diamond core bits and reaming shells. In recent years a mechanical setting method has been developed that permits a very large number of small diamonds to be set in drill bits at perfectly spaced intervals. A typical bit may contain 178 stones having an aggregate weight of 7 carats. Instead of setting stones by hand, methods for casting metal around the stones have been developed. The new bit composition "Vankolito," is a beryllium-copper alloy and is claimed to have among other advantages increased tensile strength and improved holding qualities. Beryllium is also used in beryllium-aluminum light alloys for aircraft; beryllium for x-ray tubes; as beryllium oxide in fluorescent lamps, luminous paints, special refractories, abrasive compounds, and dental cement; as beryllium nitrate by incandescent-mantle manufacturers to harden the thorium oxide skeleton. Beryllium sulfide has been used in medical research and is also said to stimulate the growth of certain seeds. Ground raw beryl is used in ceramics.

Commercial beryllium ore is sold on the basis of minimum and maximum content of beryllium oxide (BeO) in units per short ton. No beryllium reduction plants are located in the west, and beryllium ores are purchased f.o.b. eastern reduction plants. Prices quoted in the Engineering and Mining Journal (September 1947) are as follows: beryllium ore, f.o.b. mines (east of Mississippi River), of 8 percent to 12 percent BeO content, per short ton unit (20 pounds) of BeO, $14.00 to $16.00. However, the largest buyer, the Beryllium Corporation, Box 1462, Reading, Pennsylvania, quotes as follows, f.o.b. Temple, Pennsylvania: for ores containing 11 percent or over BeO, $18.00 per short-ton unit; for ores containing 9 percent to 11 percent BeO, $16.00 per short-ton unit. Ores of analysis lower than 9 percent BeO will be quoted on after analysis and tests of representative sample of not less than 10 pounds. The above are car-lot prices per dry short-ton unit, and fractions of percentages within the limits are paid in proportion.

BISMUTH

Bibliography: State Mineralogist Rept. 35; Bull. 38, 67, 91, 130.

In 1942, several hundred pounds of bismuth concentrates were made at a tungsten mine in Fresno County, but no shipments were made.

Several bismuth minerals have been found in California, notably native bismuth and bismite (the ochre) in the tourmaline gem district in San Diego and Riverside Counties near Pala. Other occurrences of bismuth minerals, including the sulphide, bismuthinite, have been noted in Inyo, Fresno, Nevada, Tuolumne, San Bernardino, and Mono Counties, but only in small quantities. The only commercial production recorded was 20 tons valued at $2,400 in 1904, credited to Riverside County.

The uses of bismuth are somewhat restricted. It is employed principally in the preparation of medicinal salts, and in low-melting-point or cliché alloys. These alloys are utilized in automatic fire-sprinkler systems, in electric fuses, and in solders.

Most of the United States production of bismuth is obtained from residues resulting from the refining of lead, copper, gold, silver, and tungsten ores and concentrates. The principal producers of refined bismuth in the United States are: American Smelting & Refining Company, Omaha, Nebraska; International Smelting & Refining Company, East Chicago, Illinois; United States Smelting, Refining & Mining Company, East Chicago, Illinois; Bunker Hill & Sullivan Mining Company, Kellogg, Idaho.

No custom smelter pays for the bismuth content of ores and concentrates of other metals; on the contrary, such ores are usually penalized if the bismuth content is over 0.1 percent. High-grade bismuth ores and concentrates are imported from Peru and Bolivia. The New York market (Engineering and Mining Journal, October 1947) quotation on refined bismuth metal, ton lots, was $2.00 per pound.

CADMIUM

Bibliography: Bull. 130. Mineral Resources U. S., 1908, 1918.

In 1944 cadmium metal was recovered from zinc ore shipped from the Big Bend mine in Butte County, to the Sullivan Mining Company at Silver King, Idaho, for reduction. In 1917-18, cadmium was recovered

by the electrolytic zinc plant of the Mammoth Copper Company in Shasta County. It was shipped in the form of "sticks" and amounted to a total of several thousand pounds for the 2 years. That was the first commercial production of cadmium recorded from California ore. Cadmium occurs there associated with zinc sulphide, sphalerite. Cadmium also occurs in the Cerro Gordo Mines, Inyo County, associated with smithsonite (zinc carbonate).

Cadmium is produced in the United States in two forms—metallic cadmium and the pigment, cadmium sulphide. The principal use of the metal is in low-melting-point, or cliché alloys, and its salts are utilized in the arts, medicine, and in electroplating. The sulphide is employed as a paint pigment, being a strong yellow, which is unaffected by hydrogen sulphide gas from coal smoke. It is also employed in coloring glass and porcelain. Cadmium cliché metal is stated to be superior to the corresponding bismuth alloy, for making stereotype plates. Cadmium is also used in bronze telegraph and telephone wires.

There are no commercial ores of cadmium. All zinc ores, however, contain cadmium in quantities ranging from traces to 2 percent. Smelter flue dusts and zinc plant purification residues are the principal sources of raw material for the production of metallic cadmium, as the element concentrates in these secondary products. There is no established price structure governing the sale of "cadmium concentrates"; prices paid by refiners vary according to analysis of the material, source of supply, and other factors. Cadmium content of zinc concentrates is never paid for by custom zinc smelters or refineries, unless by special arrangement covering concentrates exceptionally high in cadmium. Engineering and Mining Journal (September 1947) quotes cadmium metal, in sticks, per pound f.o.b. New York at $1.75.

CHROMITE

Bibliography: State Mineralogist Rept. 4, 12, 13, 14, 15, 17, 18, 21-29 (inc.), 31, 34-39 (inc.), 41; Bull. 38, 76, 91, 134; Prelim. Rept. 3. U. S. Geol. Survey Bull. 430.

Chromite is widely distributed in the serpentine rocks which occur abundantly in the Coast Ranges, Klamath Mountains, and Sierra Nevada of California. The high-grade ores occur chiefly in lenses or kidneys which are very irregular in shape and size. For this reason little ore is developed ahead of production and few deposits are developed or equipped for low-cost mining. The lower-grade ores occur as banded and disseminated deposits; they are quite extensive in Glenn, El Dorado, and Siskiyou Counties, but the grade of chromite that can be mined from them is too low to meet the specifications for metallurgical-grade ores. The United States Bureau of Mines has developed a process for making electrolytic chromium from these low-grade ores, and metallic chromium is used to make low-carbon chrome-steel alloys in the electric furnace. Prices being offered for chrome ore are such that only a few small producers remain in business. Most of the recent production has come from Del Norte County.

The major consumption of chromite ore is for use as a refractory lining in smelting furnaces for steel and copper. A smaller portion is used in the preparation of ferrochrome for chrome-steel alloys, and of chromium chemicals, the latest development of which is chrome plating

Table 19. Annual tonnage and value of chromite produced in California, 1869-1946

(Tonnage figures 1869-1918, inclusive, represent net tons of 2,000 pounds; 1919-46, recalculated to 45 percent Cr_2O_3.) NOTE: Where necessary in order to conceal output of individual producers, production figures are omitted (1946), or combined to cover a 2-year period (1932-33).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1869-83 (Del Norte, Sonoma, Placer, Calaveras Cos.)	19,000	$239,400	1902	315	$4,725	1925	191	$3,712
			1903	150	2,250	1926	393	7,063
			1904	123	1,845	1927	225	5,063
			1905	40	600	1928	729	15,179
1874-87 (San Luis Obispo County)	26,028	329,924	1906	317	2,859	1929	327	5,025
			1907	302	6,040	1930	84	1,905
			1908	350	6,195	1931	441	6,737
			1909	436	5,309	1932-33	1,206	16,587
1887	3,000	40,000	1910	749	9,707	1934	294	3,498
1888	1,500	20,000	1911	935	14,197	1935	488	6,111
1889	2,000	30,000	1912	1,270	11,260	1936	221	3,314
1890	3,599	53,985	1913	1,180	12,700	1937	1,918	20,830
1891	1,372	20,580	1914	1,517	9,434	1938	982	10,864
1892	1,500	22,500	1915	3,725	38,044	1939	3,936	52,673
1893	3,319	49,785	1916	48,943	717,244	1940	2,599	32,796
1894	3,680	39,980	1917	52,379	1,130,298	1941	17,307	355,354
1895	1,740	16,795	1918	73,955	3,649,497	1942	45,253	1,741,080
1896	786	7,775	1919	4,314	97,164	1943	56,201	2,334,838
1897	0	0	1920	1,770	43,031	1944	27,900	1,190,513
1898	0	0	1921	347	6,870	1945	10,858	431,445
1899	0	0	1922	379	6,334	1946		
1900	140	1,400	1923	84	1,658			
1901	130	1,950	1924	350	6,700	Totals	433,277	$12,902,622

as used in the automobile industry, on ships, and in oil refineries to protect metal surfaces from wear and corrosion.

Chromite shipped from California sources during 1946 came from a single property in Del Norte County. In table 17, the annual details are concealed under *Unapportioned.* The 1946 output was a decrease as compared with that of 1945, when 9,628 long tons of 45.73 percent chromite worth $431,445 was shipped from properties in Del Norte, El Dorado, Fresno, Humboldt, Placer, San Benito, San Luis Obispo, Shasta, Siskiyou, and Tehama Counties. In addition to the chromite shipped during 1946 a property in Del Norte and one in Shasta County mined small tonnages and stock-piled the ore for a future market.

Rhodesian and Philippine chrome ore has largely driven domestic ore from the market since the end of the war. However, a small market exists for California chrome ores, particularly for metallurgical-grade chromite. Prices paid for this grade, f.o.b. consumers plant (from California points), on a base of 48 percent Cr_2O_3, 3:1 chrome-iron ratio, are $32 to $36 per long ton, subject to premiums and penalties as follows: 90 cents per unit above and below 48 percent Cr_2O_3, and $1.10 per 0.1 above and below 3:1 chrome-iron ratio. Demand for chemical-grade chrome ore is completely met by imports. Refractory-grade chrome ore as imported is sold f.o.b. San Francisco for $18 per long ton, base 35 percent Cr_2O_3 with about 30 percent Al_2O_3.

Production of chromite in California began, in the period 1869-73, in Del Norte County. First production in San Luis Obispo County was in 1874. There was considerable activity in San Luis Obispo from 1880-83, and a total of 23,238 long tons (or 26,028 short tons) valued at $329,924 was shipped from that county up to the beginning of 1887. There are records of shipments from Sonoma County (before 1883), Placer County (1883 and 1884), and Calaveras County. Apparently the state's total in the period 1869-83 was some 45,000 tons.[1] Table 19 shows the annual

[1] Day, D. T., History of the chromium industry: Mineral Resources U. S., 1883-84, pp. 569, 570, 1885.

output of chromite in California, including the earliest figures so far as they are available. The figures from 1887 to date are from the records of the State Mining Bureau.

COBALT

Bibliography: State Mineralogist Rept. 14, 33, 34, 37; Bull. 67, 91. U. S. Bur. Mines Inf. Circ. 6331.

Occurrences of some of the cobalt minerals have been noted in several localities in California, but no commercial production has resulted to date. Some of the copper ores of the foothill copper belt in Mariposa and Madera Counties have been found to contain cobalt up to 3 percent.

The nominal quotation for cobalt (Aug. 7, 1947) is $1.65 per pound for the refined 97 to 99 percent metal in lots of 500 pounds.

The most important use of cobalt is in the manufacture of the alloy stellite in which it is combined with chromium for making high speed lathe tools, non-tarnishing cutlery, and surgeons' appliances. The metal is also used in electroplating, similarly to nickel; and the oxide, carbonate, chloride, sulfate, and other salts are used in ceramics for coloring. Some of the organic salts of cobalt (acetate, resinate, oleate) are employed as driers in paint and varnish.

COPPER

Bibliography: State Mineralogist Rept. 8-39 (inc.); Bull. 23, 50, 91.

Most of the copper recently mined in California is in the form of a complex heavy sulfide containing much pyrite, much zinc sulfide, and a little lead. Separation of these minerals is made by the flotation process, but the recoveries of the individual metals leave much to be desired. Improvements in this process would help to increase profits from the mines. The process is expensive because extremely fine grinding is necessary.

The principal producers of this type of ore are the Hornet mine, Shasta County, and the Penn mine in Calaveras County. The Gray Eagle in Siskiyou County and the Keystone in Calaveras County, which were important producers during the war, have been shut down.

Copper production in California is at a low ebb chiefly because of war-time depletion of known reserves. The mines that were operated in 1946 were dependent for a profit on premiums paid by the United States Government, and these were discontinued on July 1, 1947. Future production of California probably depends upon the making of new discoveries, and such discoveries may not be made until better methods are available, such as improved combinations of geological and geophysical surveys.

The output of copper in California during 1946 amounted to 8,377,352 pounds of recoverable metal worth $1,357,131, and came from properties in 15 counties. The 1946 production showed a decrease in both amount and value as compared with that of 1945, when 13,949,675 pounds of recoverable metal worth $1,883,206 was mined and shipped from properties in 13 counties. The average price received by the miner, including subsidy, during 1946, was 16.2 cents per pound, compared with 13.5 cents per pound in 1945; 13.5 cents per pound in 1944; 13.0 cents per pound in 1943; 12.1 cents per pound in 1942; 11.8 cents per pound in 1941; and 11.3 cents per pound in 1940. On June 30, 1947, the government stopped paying subsidies on copper.

Table 20. Production of copper during 1946, by county

NOTE: Where necessary in order to conceal output of a single producer in a county, production figures have been combined under "Unapportioned".

County	Pounds	Value	County	Pounds	Value
Amador	2,041,536	$330,729	Unapportioned (Del Norte, El Dorado, Mariposa, Nevada, Orange, Plumas, Riverside, Trinity, Tuolumne)	9,224	$1,494
Butte	24,202	3,921			
Calaveras	1,859,691	301,270			
Inyo	446,386	72,315			
San Bernardino	83,366	13,505			
Shasta	3,912,947	633,897	Totals	8,377,352	$1,357,131

Table 21. Annual poundage and value of copper produced in California, 1882-1946

Year	Pounds	Value	Year	Pounds	Value	Year	Pounds	Value
1882	826,695	$144,672	1905	16,997,489	$2,650,605	1927	27,350,316	$3,582,888
1883	1,600,862	265,743	1906	28,726,448	5,522,712	1928	25,162,304	3,623,360
1884	876,166	120,911	1907	32,602,945	6,341,387	1929	33,809,258	5,941,799
1885	469,028	49,248	1908	40,868,772	5,350,777	1930	26,534,752	3,449,522
1886	430,210	43,021	1909	65,727,736	8,478,142	1931	12,954,842	1,178,890
1887	1,600,000	192,000	1910	53,721,032	6,680,641	1932	1,417,536	89,307
1888	1,570,021	235,303	1911	36,838,024	4,604,753	1933	992,515	63,521
1889	151,505	18,180	1912	34,169,997	5,638,049	1934	590,638	47,252
1890	23,347	3,502	1913	34,471,118	5,343,023	1935	2,031,836	168,645
1891	3,397,405	424,675	1914	30,491,535	4,055,375	1936	9,991,799	919,245
1892	2,980,944	342,808	1915	40,968,966	7,169,567	1937	10,512,500	1,272,013
1893	239,682	21,571	1916	55,809,019	13,729,017	1938	1,613,491	158,122
1894	738,594	72,486	1917	48,534,611	13,249,948	1939	8,390,215	872,582
1895	225,650	21,901	1918	47,793,046	11,805,883	1940	12,833,363	1,450,170
1896	1,922,844	199,599	1919	22,162,605	4,122,246	1941	8,101,449	955,970
1897	13,638,626	1,540,666	1920	12,947,299	2,382,303	1942	2,138,149	258,716
1898	21,543,229	2,475,168	1921	12,088,053	1,559,358	1943	17,172,440	2,232,417
1899	23,915,486	3,990,534	1922	22,883,987	3,090,582	1944	25,584,865	3,453,957
1900	29,515,512	4,748,242	1923	28,346,860	4,166,989	1945	13,949,675	1,883,206
1901	34,931,788	5,501,782	1924	52,089,349	6,823,704	1946	8,377,352	1,357,131
1902	27,860,162	3,239,975	1925	46,968,499	6,669,527			
1903	19,113,861	2,520,997	1926	33,521,544	4,693,014	Totals	1,265,784,000	$197,229,294
1904	29,974,154	3,969,995						

Although some mining of copper ores had been done earlier, shipments in appreciable quantities began in 1861 and continued to the end of 1867, when a total of 68,631 tons (of 2376 pounds) of high-grade ores, and 847 tons of matte or "regulus"[2] had been shipped to smelters at New York, Boston, and Swansea, Wales. The most important district at that time was Copperopolis and vicinity, in Calaveras County. Some shipments were also made from Mariposa, El Dorado, Fresno, and San Luis Obispo Counties. From 1868-82, the output was insignificant. There are wide discrepancies in the figures recorded for copper production prior to 1882, when the U. S. Geological Survey began to collect data. Compilation of detailed statistics by the California State Mining Bureau began in 1894.

GOLD

Bibliography: State Mineralogist Rept. 1-41 (inc., except 3, 8, 41) ; Bull. 36, 45, 57, 91, 95, 108, 135. U. S. Geol. Survey Prof. Paper 73.

Billions of dollars worth of recoverable gold undoubtedly still remain in veins and ancient placer deposits in California. That California has always been a gold-mining state is well known throughout the world, but the demand for industrial minerals, increasing with growth of population, is fast overshadowing the older, more romantic mining industry.

[2] Browne, J. Ross, Mineral resources of the States and Territories west of the Rocky Mountains for 1867, p. 168.

California's gold mines with few exceptions were shut down during World War II by Limitation Order L-208 of the War Production Board, which was in effect from October 8, 1942 to July 1, 1945. In 1944 production dropped to $4,108,055, the lowest since 1848, the year in which Marshall discovered gold at Sutter's saw mill. The 1940 production of $50,948,485 is in sharp contrast. Other factors tending to shut down the gold mines were in effect even before October 1942, such as rising cost of labor and supplies and the policy of the Government in diverting labor from gold mines to war industry; hence, some of the gold mines had already closed when the Limitation Order of the War Production Board was issued.

The period of idleness caused great damage to many of the mines in the form of caved and flooded workings. High prices of labor and materials and high taxes, together with fixed price of gold of $35.00 per ounce, have forced operators to keep many of the underground mines closed.

Dredging properties, particularly those equipped with connected-bucket dredges, were much less affected than the underground mines, and deterioration was slight. Properties equipped with dragline dredges were adversely affected because the dragline excavators were in demand for war work, both as excavators and as cranes, and were scattered and worn out on such work. The washing plants, like the connected-bucket dredges, were not adaptable to war work and remained on the placer-mining properties.

The industry is slowly reviving, but such factors as high cost of labor and supplies and scarcity of both are still retardants. Extensive repair jobs on caved workings are necessary in some of the mines. Persons responsible for management of the few large underground mines that are reopening must use every possible device to increase the output of labor, such as incentive pay systems and more extensive mechanization. For instance, hand-shoveling must be considered in the luxury class from the standpoint of management, and every effort must be made to move ore and waste either by gravity or with mechanical shovels and scrapers. Incentive pay brings the miner a larger day's wage for a larger day's work and makes his earnings comparable to those of other skilled trades. Development work is active at a number of small lode mines, where an effort is being made to find new ore bodies.

Dragline dredging is also rather slow to revive, chiefly because dragline excavators are in short supply, hard to get, and high in price. The cost of labor on a dragline dredge forms a higher percentage of total cost of operation than on a connected-bucket dredge; hence present high cost of labor is a factor in holding back the revival of dragline dredging.

Connected-bucket dredges are resuming production as fast as crews can be assembled and machinery repaired. On most of these dredges machinery is intact, and only maintenance work is needed to put them back in operation. Cost of labor is only about 20 percent of total cost in this type of gold production, contrasted with 50 percent in underground lode mining; hence dredging with connected-bucket dredges is affected less by high wages. Dredging of this type is being revived at a higher rate than other types of gold mining.

Gold was for many years the most important single mineral product of California. Although now surpassed for a number of years in annual value by petroleum, and by natural gas from 1923-32 and 1943-46, gold headed the metal list until 1943. It was then passed in value by both

Table 22. Mine production of lode and placer gold during 1946, by county

(Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property)

County	Lode mines	Placer mines	Fine ounces	Value	County	Lode mines	Placer mines	Fine ounces	Value
Amador	10	9	2,638	$92,330	Riverside	2	-------	3	$105
Butte	4	12	21,953	768,355	Sacramento	-------	10	100,275	3,509,625
Calaveras	9	10	6,602	231,070	San Bernardino	17	1	4,901	171,535
Del Norte	1	-------	24	840	San Diego	1	-------	2	70
El Dorado	4	9	2,723	95,305	San Francisco (property not classed aa a mine)	-------	1	28	980
Fresno	1	4	272	9,520	San Joaquin	-------	3	13,715	480,025
Humboldt	-------	1	64	2,240	Shasta	6	10	12,825	448,875
Imperial	2	-------	203	7,105	Sierra	11	8	11,427	399,945
Inyo	16	-------	3,096	108,360	Siskiyou	8	22	8,706	304,710
Kern	17	3	2,706	94,710	Stanislaus	-------	2	24,158	845,530
Los Angeles	-------	1	36	1,260	Trinity	2	23	13,962	488,670
Madera	-------	3	55	1,925	Tuolumne	12	2	1,662	58,170
Mariposa	9	3	3,490	122,150	Yuba	1	10	57,991	2,029,685
Merced	-------	3	3,732	130,620	Totals	150	172	356,824	$12,488,840
Mono	3	1	926	32,410					
Nevada	6	4	55,168	1,930,880					
Orange	1	-------	14	490					
Placer	3	14	3,116	109,060					
Plumas	4	4	351	12,285					

Table 23. Twenty-five leading gold-producing mines in California in 1946, in order of output

Rank	Mine	District	County	Rank in 1945	Operator	Source of gold
1	Natomas Company	Folsom	Sacramento	2	Natomas Company	Dredge
2	Yuba unit	Yuba River	Yuba	1	Yuba Consolidated Gold Fields	Dredge
3	Idaho Maryland and New Brunswick	Grass Valley-Nevada City	Nevada	3	Idaho Maryland Mines Corporation	Gold ore
4	Tuolumne gold dredge	La Grange	Stanislaus	6	Tuolumne Gold Dredging Corporation	Dredge
5	Capital dredge	Folsom	Sacramento	9	Capital Dredging Co.	Dredge
6	Upper and Lower Camanche dredge	Camanche	San Joaquin	5	Gold Hill Dredging Co.	Dredge
7	Junction City	Junction City	Trinity	21	Junction City Mining Co.	Dredge
8	Butte unit	Oroville	Butte	15	Yuba Consolidated Gold Fields	Dredge
9	La Grange Dredge No. 4	La Grange	Stanislaus	11	La Grange Gold Dredging Co.	Dredge
10	Original Sixteen to One	Alleghany	Sierra	8	Original Sixteen to One Mine, Inc.	Gold ore
11	Empire Star group	Grass Valley-Nevada City	Nevada	4	Empire Star Mines Co., Ltd.	Gold ore
12	Lancha Plana Dredge No. 4	Folsom	Sacramento	25	Lancha Plana Gold Dredging Co.	Dredge
13	Thurman dredge	Redding	Shasta	18	Thurman Gold Dredging Co.	Dredge
14	Kister	Oroville	Butte	14	Gold Hill Dredging Co.	Dredge
15	Thurman & Wright	Cosumnes River	Sacramento	No prod.	Thurman & Wright	Dredge
16	Ancho and Erie groups	Washington	Nevada	12	Ancho-Erie Mining Co.	Gold ore
17	Clear Creek	French Gulch	Shasta	13	French Gulch Dredging Co.	Gold ore
18	Lancha Plana Dredge No. 5	Butte Creek	Butte	No prod.	Lancha Plana Gold Dredging Co.	Dredge
19	Penn	Campo Seco	Calaveras	10	Shawmut Copper Mine Co.	Zinc ore
20	Mount Gaines	Hunter Valley	Mariposa	20	Mount Gaines Mining Co.	Gold ore
21	Yreka gold dredge	Klamath River	Siskiyou	24	Yreka Gold Dredging Co.	Dredge
22	Scandia Nos. 1-2-3	Klamath River	Siskiyou	No prod.	Larsen and Harms	Dredge
23	Brush Creek	Downieville	Sierra	19	Alfred L. Merritt	Gold ore
24	Merced Dredge No. 1	Snelling	Merced	17	Merced Dredging Co.	Dredge
25	Siskiyou unit	Callahan	Siskiyou	23	Yuba Consolidated Gold Fields	Dredge

Table 24. Annual amount and value of gold produced in California, 1848-1946

(Figures from 1903-23 prepared by U. S. Geological Survey; 1924-46, by U. S. Bureau of Mines. Values calculated on the following bases: 1848-1932, inclusive, average weighted price of $20.6718 per fine oz.; 1933, average weighted price of $25.56 per fine oz.; 1934, average weighted price of $34.95 per fine oz.; 1935-46, $35.00 per fine oz.)

Year	Fine ounces	Value	Year	Fine ounces	Value	Year	Fine ounces	Value
1848	11,866	$245,301	1882	829,458	$17,146,416	1916	1,035,745	$21,410,741
1849	491,072	10,151,360	1883	1,176,329	24,316,873	1917	971,733	20,087,504
1850	1,996,586	41,273,106	1884	657,900	13,600,000	1918	799,588	16,528,953
1851	3,673,512	75,938,232	1885	612,478	12,661,044	1919	807,667	16,695,955
1852	3,932,631	81,294,700	1886	711,911	14,716,506	1920	692,297	14,311,043
1853	3,270,803	67,613,487	1887	657,349	13,588,614	1921	759,721	15,704,822
1854	3,358,867	69,433,931	1888	616,000	12,750,000	1922	709,678	14,670,346
1855	2,684,106	55,485,395	1889	542,425	11,212,913	1923	647,210	13,379,013
1856	2,782,018	57,509,411	1890	595,486	12,309,793	1924	636,140	13,150,175
1857	2,110,513	43,628,172	1891	615,759	12,728,869	1925	632,035	13,065,330
1858	2,253,846	46,591,140	1892	608,186	12,571,900	1926	576,798	11,923,481
1859	2,217,829	45,846,599	1893	606,664	12,538,780	1927	564,586	11,671,018
1860	2,133,104	44,095,163	1894	670,636	13,863,282	1928	521,740	10,785,315
1861	2,026,187	41,884,995	1895	741,798	15,334,317	1929	412,479	8,526,703
1862	1,879,595	38,854,668	1896	831,158	17,181,562	1930	457,200	9,451,162
1863	1,136,897	23,501,736	1897	767,779	15,871,401	1931	523,135	10,814,162
1864	1,164,455	24,071,423	1898	769,476	15,906,478	1932	569,167	11,765,726
1865	867,405	17,930,858	1899	741,881	15,336,031	1933	613,579	15,683,075
1866	828,367	17,123,867	1900	767,390	15,863,355	1934	719,064	25,131,284
1867	883,591	18,265,452	1901	821,845	16,989,044	1935	890,430	31,165,050
1868	849,265	17,555,867	1902	818,037	15,910,320	1936	1,077,442	37,710,470
1869	881,830	18,229,044	1903	788,544	16,300,653	1937	1,174,578	41,110,230
1870	844,537	17,458,133	1904	901,484	18,633,676	1938	1,311,129	45,889,515
1871	845,493	17,477,885	1905	914,217	18,898,545	1939	1,435,264	50,234,240
1872	748,951	15,482,194	1906	906,182	18,732,452	1940	1,455,671	50,948,485
1873	726,554	15,019,210	1907	809,214	16,727,928	1941	1,408,793	49,307,755
1874	835,186	17,264,836	1908	907,590	18,761,559	1942	847,997	29,679,895
1875	816,377	16,876,009	1909	979,007	20,237,870	1943	148,328	5,191,480
1876	735,169	15,610,723	1910	953,734	19,715,440	1944	117,373	4,108,055
1877	798,249	16,501,268	1911	954,870	19,738,908	1945	147,938	5,177,830
1878	911,343	18,839,141	1912	953,640	19,713,478	1946	356,824	12,488,840
1879	949,439	19,626,654	1913	987,187	20,406,958			
1880	968,986	20,030,761	1914	999,113	20,653,496	Totals	101,866,231	$2,267,062,286
1881	929,920	19,223,155	1915	1,085,646	22,442,296			

quicksilver and tungsten ore and by tungsten ore in 1944. In 1946 gold again tops the metals in value of output. Prior to 1943 California outranked all other gold-producing states in the United States for many years, and in 1946 has regained the lead. The gold production in California during 1946 totaled 356,824 fine ounces valued at $12,488,840, being an increase of 208,886 fine ounces over the 1945 yield, which was 147,938 fine ounces worth $5,177,830. The lode or deep mines during 1946 accounted for 87,052 fine ounces worth $3,046,820, and the placers (mainly bucket-line and dragline dredges) produced 269,772 fine ounces worth $9,442,020.

As the Division of Mines has never independently gathered the statistics of gold and silver production, these figures, as in former years, are published by cooperation with and through the courtesy of Alfred L. Ransome of the Division of Mineral Statistics, United States Bureau of Mines.

The three leading counties in gold output during 1946 were Sacramento, Yuba, and Nevada, each with a value of production over a million dollars. The gold from Nevada County came chiefly from lode mines, whereas that from Sacramento and Yuba Counties was mainly from bucket-line dredges.

The following statement and table 23 are quoted from an advance statement on gold mining during 1946, from Minerals Yearbook for 1946, chapter reprint, *Gold, Silver, Copper, Lead, and Zinc in California*, by the United States Bureau of Mines:

"*Gold.* Production of 356,824 ounces of gold in California in 1946 was nearly 1½ times the output in 1945. Although 1946 was the second year of increase from the low point of 117,373 ounces in 1944 under the War Production Board Limitation Order L-208, the value of the output ($12,488,840) was only 25 percent of the $50,948,485 in gold produced in 1940, the largest value since 1856. The marked increase in the production of gold since the rescinding of Order L-208 July 1, 1945, was largely due to the rapid acceleration in placer mining, principally by connected-bucket dredging. The rate of increase in production would have been even greater had lode gold mining been re-established with equal rapidity. With the exception of a few properties, many of the mines that were large producers before the war had not reopened, and one famous producer, the Empire Star Mines Co., Ltd., in the Grass Valley district, Nevada County, closed down operation of its Empire Star group of mines July 1, 1946. The principal reasons for this shut-down, as well as the failure of so many other properties to reopen at all, were the fixed price for gold and the over-all inflationary trend which affected all costs of mining and labor.

"Monthly production of gold in 1946 gained rapidly during the first 3 months to continue the swing upward which began in July 1945. From March through July the monthly output remained relatively unchanged at about 29,700 ounces. Following a rise to 34,340 ounces in August, the monthly rate of production again leveled off for the balance of the year. The monthly average for the year was 29,735 ounces compared with 12,328 ounces for 1945 and 9,781 ounces for 1944. Monthly production figures since January 1937 through the war years have been discussed in detail in this chapter for 1944 and 1945.

"The 25 leading gold-producing mines in California in 1945, listed in table [23], yielded 88 percent of the total gold output of the state; the leading five mines produced 56 percent and the leading 10 mines, 70 percent."

IRON AND STEEL

Bibliography: State Mineralogist Rept. 2, 4, 5, 10, 12-15 (inc.), 17, 18, 21-27 (inc.), 30, 31, 33-36 (inc.), 38, 39, 40; Bull. 38, 67, 91, 113, 129. Am. Inst. Min. Met. Eng. Trans., vol. 53, 466 pp.

Large deposits of high-grade iron ore have for many years been known to exist in California. The first production of pig iron was in the early eighties, from the blast furnaces then in operation at Hotaling, Placer County. Charcoal was used in lieu of coke. Though a superior grade of metal was produced, the furnaces were finally closed down, as they could not compete with the cheaper English and eastern United States iron brought in by sea to San Francisco.

Table 25. Annual tonnage and value of iron ore produced in California, 1881-1946

(Production from 1881-86 inclusive reported as tons of pig iron, in Mineral Resources U. S., 1885; tonnage figures in this table have been recalculated to tons of ore on the basis of 47.6 percent Fe, the average iron content shown in analyses of the ore published in Report 4 of the State Mineralogist, p. 242. Tonnage figures used in this table represent net tons of 2,000 pounds.) NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1924-25, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1881	9,273	$79,452	1912	2,508	$2,508	1930-31	100	$700
1882	2,073	17,766	1913	2,343	4,485	1932	0	0
1883	11,191	106,540	1914	1,436	5,128	1934-35	38,339	163,714
1884	4,352	40,983	1915	724	2,584	1936	31,084	155,434
1885	0	0	1916	3,000	6,000	1937	5,490	29,340
1886	3,676	19,250	1917	2,874	11,496	1938	27,878	141,406
1887	0	0	1918	3,108	15,947	1939	16,990	77,788
1893	250	2,000	1919	2,300	13,796	1940-41	54,707	194,362
1894	200	1,500	1920	5,975	40,889	1942	99,092	371,562
1895	0	0	1921	1,970	12,030	1943	907,458	2,341,827
1907	400	400	1922	3,588	18,868	1944	905,981	2,360,694
1908	0	0	1923	3,102	18,665	1945	240,917	883,434
1909	108	174	1924-25	785	4,710	1946	428,354	1,061,956
1910	579	900	1926-27	5,272	26,000			
1911	558	558	1928	0	0	Totals	2,828,035	$8,234,846

Commercial production of pig iron actually began in this state January 1, 1943, when the blast furnace of the Kaiser Company's plant at Fontana was blown in. Since that time capacity production, 1200 tons of hot metal per day, has been maintained, with the exception of a short period immediately following the war. To January 1, 1947, 1,307,996 tons of hot metal had been produced. By far the greater part of the ore fed to this furnace came from the company-owned Vulcan mine, 9 miles south of Kelso in San Bernardino County. To January 1, 1947, this property had shipped 2,103,448 tons, always maintaining a minimum of 50 percent iron content. Operations will be discontinued July 1, 1947, and mining activities will be transferred to the Eagle Mountain deposits in eastern Riverside County. The Vulcan mine is being abandoned because the operators are faced either with excessive stripping costs or expensive underground mining; also because of the increased sulphur content of the ore. By July 1 sufficient ore will have been stockpiled at Kelso and the Vulcan mine to carry furnace operations during the period of moving to the Eagle Mountain deposits.

The Eagle Mountain deposits have been drilled and trenched. This work developed 25,000,000 tons of blast-furnace-grade ore and it is estimated that an additional 45,000,000 tons can be made available by beneficiation. Development of this property includes the construction of 51 miles of railroad, which will be built and operated by the company, and which is expected to be in operation by April 1948.

Other shipments of iron ore, in quantity, come from the Cave Canyon deposit of the California Portland Cement Company. This deposit is in San Bernardino County and supplies from 30,000 to 60,000 tons per year to the company's plant at Colton and the Riverside Cement Company's plant at Crestmore. No curtailment of these shipments is anticipated.

Total steel production in California in 1942, the year before the Fontana steel furnaces were started, was 1,041,046 tons. The open-hearth section at Fontana consists of six 185-ton furnaces having a monthly capacity of 60,000 tons. These furnaces were put into operation in May 1943. To January 1, 1947, 1,950,000 tons of steel had been produced. Finishing facilities are as follows: plate mill with an annual rated capacity of 300,000 tons; structural mill with a capacity of 210,000 tons per year; merchant mill, 180,000 tons per year. In addition to these, construction is now in progress on the following: pipe mill to produce 125,000 tons annually; cold-roll mill for light-weight strip 42,000 tons; cold-draw plant 24,000 tons, rounds, flats, squares, and hexagonals.

The iron ore shipped during 1946 from California properties totaled 428,354 net tons valued at $1,061,956 and came from two properties in San Bernardino County and a single property each in Los Angeles, Riverside, and Shasta Counties, as compared with 240,917 net tons worth $883,434 during 1945, which came from a single property each in Riverside, San Bernardino, Santa Cruz, and Shasta Counties.

The ore mined during 1946 was hematite from Riverside and San Bernardino Counties; magnetite from Shasta County; and magnetite sand from Los Angeles County.

Several deposits of iron ore are known in California, notably in Shasta, Madera, Placer, Plumas, Riverside, San Bernardino, and Los Angeles Counties. Some pig iron was made in earlier years, utilizing charcoal for fuel, both in blast furnaces and by electrical reduction. Ferrochrome, ferromanganese, and ferrosilicon have also been made in California.

LEAD

Bibliography: State Mineralogist Rept. 4, 8-15 (inc.), 17-28 (inc.), 30, 31, 33-36 (inc.), 39, 41.

There are important deposits of lead in the desert mountain ranges of California, especially in Inyo County. These occur as replacement deposits in Paleozoic or older limestones.

Increase in the price of lead to 14.8 to 15 cents per pound in 1947, together with a steady demand and diminishing stocks, place this metal in a very strong position. These conditions are responsible for increased activity in the exploration for and production of lead in California. The steady increase for the past 3 years is shown by the follow statistics:

Year	Pounds	Value	Cents per pound
1944	11,408,381	$912,670	8
1945	14,504,767	1,247,410	8.6
1946	20,432,630	2,227,157	10.9

The 1946 production has been exceeded only once in the state's history. In 1917 the output was 21,651,352 pounds valued at $1,862,016 or 8.60 cents per pound. Present indications are that the 1947 production will equal if not exceed that of 1946.

Anaconda Copper Mining Company, operating at Darwin, produced more than three-quarters of the 1946 output and has recently increased the capacity of its concentrator. Most of the lead from Darwin ores is recovered by direct smelting. The Finley Company, operating Columbia No. 2 mine (formerly operated by Shoshone Mines Company) was the second largest producer in the state for 1946. This property is 9 miles east of Tecopa in Inyo County. Its production will be increased as a mill is now under construction for treatment of ores which could not be shipped. In the past all ore from this property has been shipped directly to the smelter. Dunton-Ray and Greenwood, shipping from the Mohawk mine in eastern San Bernardino County, were third in production.

Morris Albertoli and associates are doing development work on the Black Canyon (Mineral Point) mine in the White Mountains in Inyo County. Some ore has been shipped from the property and it appears that a substantial production may eventually be attained. Shipments of dump ores from the Santa Rosa mine in Inyo County are being made regularly to the smelter. Rehabilitation of this mine has been going forward, and shipments from the mine may be expected in the near future.

This upward trend in the production of lead in the state may be expected to continue as long as the price of the metal is sufficiently high to offset increased labor costs.

Table 26. Production of lead during 1946, by county

NOTE: Where necessary in order to conceal output of a single producer in a county, production figures have been combined under "Unapportioned".

County	Pounds	Value	County	Pounds	Value
Calaveras	320,178	$34,900	Unapportioned (Amador, Butte, El Dorado, Mariposa, Nevada, Orange)	13,445	$1,466
Inyo	19,124,830	2,084,606			
San Bernardino	947,067	103,230			
Shasta	27,110	2,955	Totals	20,432,630	$2,227,157

Table 27. Annual poundage and value of lead produced in California, 1877-1946

(Poundage figures, 1877-81, inclusive, after C. E. Siebenthal, Mineral Resources U. S., 1912, pt. 1, p. 339; value figures, 1877-81, from quotations in Engineering and Mining Journal; poundage, 1882, estimated; poundage and value figures, 1883-86 inclusive, from Mineral Resources U. S., 1883-86 respectively; figures from 1887 to date compiled by State Division of Mines.)

Year	Pounds	Value	Year	Pounds	Value	Year	Pounds	Value
1877	7,836,000	$391,800	1901	720,500	$28,820	1925	7,352,422	$639,661
1878	8,640,000	328,320	1902	349,440	12,230	1926	8,067,873	645,429
1879	4,502,000	191,335	1903	110,000	3,960	1927	2,748,440	173,151
1880	4,200,000	215,460	1904	124,000	5,270	1928	1,882,795	109,102
1881	6,680,000	325,316	1905	533,680	25,083	1929	1,428,777	90,014
1882	4,000,000	196,800	1906	338,718	19,307	1930	3,542,796	176,241
1883	3,400,000	145,520	1907	328,681	16,690	1931	3,934,240	245,568
1884	3,200,000	120,512	1908	1,124,483	46,663	1932	2,418,626	72,480
1885	2,000,000	80,900	1909	2,685,477	144,897	1933	772,463	28,583
1886	2,000,000	93,400	1910	3,016,902	134,082	1934	804,911	29,655
1887	1,160,000	52,200	1911	1,403,839	63,173	1935	1,142,405	45,695
1888	900,000	38,250	1912	1,370,067	61,653	1936	1,098,545	50,533
1889	840,000	35,720	1913	3,640,951	160,202	1937	2,402,110	141,724
1890	800,000	36,000	1914	4,697,400	183,198	1938	1,003,096	46,142
1891	1,140,000	49,020	1915	4,796,299	225,426	1939	1,061,294	49,880
1892	1,360,000	54,400	1916	12,392,031	855,049	1940	3,092,636	154,632
1893	666,000	24,975	1917	21,651,352	1,862,016	1941	6,900,851	393,348
1894	950,000	28,500	1918	13,464,869	956,006	1942	10,329,176	692,054
1895	1,592,400	49,364	1919	4,139,562	219,397	1943	11,811,034	885,827
1896	1,293,500	38,805	1920	4,903,738	392,300	1944	11,408,381	912,670
1897	596,000	20,264	1921	1,149,051	51,707	1945	14,504,767	1,247,410
1898	655,000	23,907	1922	6,511,280	358,120	1946	20,432,630	2,227,157
1899	721,000	30,642	1923	9,934,522	695,416			
1900	1,040,000	41,600	1924	4,984,387	398,751	Totals	282,783,397	$18,589,382

MANGANESE

Bibliography: State Mineralogist Rept. 12-15 (inc.), 18, 22-27 (inc.), 29-31 (inc.), 33-41 (inc.) ; Bull. 38, 67, 76, 91, 125. U. S. Geol. Survey Bull. 427. Eng. and Min. Jour. Press, vol. 117, p. 545.

Nearly 1000 manganese deposits are known, located in 44 of California's 58 counties. The most important producing counties, in terms of total past production, are Alameda, Imperial, Mendocino, Plumas, Riverside, San Joaquin, San Luis Obispo, Santa Clara, Stanislaus, and Trinity. Though some of the deposits have been almost mined out, many still contain sizable reserves of low grade siliceous ore, which in the advent of another war might prove attractive to the miner.

The deposits in southwest Stanislaus and southeast Alameda Counties, though relatively low in grade, proved to be desirable for making batteries. A plant was set up near Patterson, California, during the last war to beneficiate the ore, but it has now been dismantled and the machinery shipped away.

California in war time has been one of the principal producers of manganese in the United States. Between 1941 and 1944, California mined more than 50,000 tons of manganese and was exceeded in production only by the State of Montana. Most California manganese is relatively low in grade and high in silica, which makes it undesirable for normal uses, but during war time, when the demand for domestic manganese is high, manufacturers are less insistent upon peace-time specifications. Hence, with the rise in price, many manganese properties can be mined profitably. However, with the return to normal peacetime activities, the demand for California manganese has diminished. California production was 21,540 long tons in 1944 and 1,668 long tons in 1945. In 1946 a little was mined but not sold.

Table 28. Annual tonnage and value of manganese produced in California, 1887-1946

(Tonnage figures used in this table represent net tons of 2,000 pounds.) NOTE: Where necessary in order to conceal output of individual producers, production figures are omitted (1946), or combined to cover a 2-year period (1928-29, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1887	1,000	$9,000	1906	1	$30	1925	832	$19,450
1888	1,500	13,500	1907	1	25	1926	235	4,700
1889	53	901	1908	321	5,785	1927	0	0
1890	386	3,176	1909	3	75	1928-29	733	8,216
1891	705	3,830	1910	265	4,235	1930-31	207	2,576
1892	300	3,000	1911	2	40	1932	0	0
1893	270	4,050	1912	22	400	1934-35	432	4,630
1894	523	5,512	1913	0	0	1936	0	0
1895	880	8,200	1914	150	1,500	1939	6	45
1896	518	3,415	1915	4,013	49,098	1940	314	3,206
1897	504	4,080	1916	13,404	274,601	1941	3,565	75,057
1898	440	2,102	1917	15,515	396,659	1942	17,362	505,190
1899	295	3,165	1918	26,075	979,235	1943	25,729	957,317
1900	131	1,310	1919	11,569	451,422	1944	30,263	1,098,555
1901	425	4,405	1920	2,892	62,323	1945	1,875	86,270
1902	870	7,140	1921	1,005	12,210	1946		
1903	1	25	1922	540	7,650			
1904	60	900	1923	690	10,620	Totals	167,997	$5,124,616
1905	0	0	1924	1,115	25,785			

Production of manganese ore in California began at the Ladd mine, San Joaquin County, Telsa district, in 1867. When shipments of this ore to England ceased late in 1874, more than 5000 tons had been produced from that property. For some years following, the output was small. Table 28 shows California's output of manganese ore, annually, since 1887, when the compilation of such figures was begun by the State Mining Bureau.

The market for manganese ores in California is very dull at present. Most of the demand is met by imports of Philippine ore. What ore of metallurgical grade is sold brings from 50 cents to 65 cents per long-ton unit of manganese, based on 48 percent Mn. The demand for battery-grade and chemical-grade manganese ore is weak. This grade ore brings $60.00 to $70.00 per long ton, base 50 percent Mn; specifications are rigid and high MnO_2 content (at least 85 percent) is required. Other specifications vary with the individual purchaser. Above prices quoted are f.o.b. buyer's plant in California. Corresponding New York prices (Engineering and Mining Journal, October 1947) are: metallurgical grade, base 48 percent Mn, per long-ton unit, subject to premiums and penalties, f.o.b. cars Atlantic seaports, duty paid, 63 to 66 cents.

MOLYBDENUM

Bibliography: State Mineralogist Rept. 14, 17-24 (inc.), 26-28 (inc.), 30, 34, 35, 36, 39; Bull. 67, 91, 130. U. S. Bur. Mines Bull. 111. Colorado Sci. Soc. Proc., vol. 11.

During 1946 the mill of the United States Vanadium Corporation on Pine Creek near Bishop, Inyo County, resumed production of molybdenum concentrates. This mill had been shut down in 1945, and no shipments were made.

Molybdenum is used as an alloy constituent of high alloy steel, and in certain forms of electrical apparatus. Included in the latter is its successful substitution for platinum and platinum-iridium in electric contact-making and -breaking devices. In alloys it is used similarly to and in conjunction with chromium, cobalt, iron, manganese, nickel,

Table 29. Annual poundage and value of molybdenum ore produced in California, 1916-46

NOTE: Where necessary in order to conceal output of individual producer, production figures are combined to cover a 2-year period (1933-34, etc.).

Year	Pounds of MoS_2	Value	Year	Pounds of MoS_2	Value
1916	9,280	$9,945	1939-40	383,233	$147,126
1917	7,290	9,014	1941-43	3,775,566	1,228,203
1918	0	0	1944	1,778,101	599,589
1919	270	300	1946		
1933-34	1,306	306	Totals	5,955,046	$1,994,483

tungsten and vanadium. The oxides and the ammonium salt have important chemical uses.

The growing consumption of molybdenum by alloy-steel makers in the United States has been stimulated by the fact that molybdenum alone of the steel-alloying metals can be produced commercially in the United States to an extent which avoids all necessity for importation. Another fact has been the marked adaptability of molybdenum steels to large-scale production of automobile and other parts.

The present (August 7, 1947) quotations on molybdenum ores are 45 cents per pound of MoS_2 contained, f.o.b. mine; on ferromolybdenum, 95 cents per pound Mo, 55 percent to 65 percent Mo, f.o.b. shipping point.

The two principal molybdenum minerals are the sulphide, molybdenite, and wulfenite, lead molybdate. The former furnishes practically the entire commercial output. Molybdenite is found in or associated with acidic igneous rocks, such as granite and pegmatite.

Deposits of disseminated molybdenite are known in several localities in California, and in at least two places it occurs in small masses associated with copper sulphides. The first recorded commercial shipments of molybdenum ore in California were during the first World War, 1916-18. Some development work has been done on a high-grade deposit at the head of the Kaweah River, Tulare County.

PLATINUM

Bibliography: State Mineralogist Rept. 4, 8, 9, 12-26 (inc.), 28, 30, 31, 34-37 (inc.); Bull. 38, 45, 67, 85, 91, 92. U. S. Geol. Survey Bull. 193, 285. Am. Inst. Min. Met. Eng. Trans. vol. 47, pp. 217-218.

The platinum produced in California comes entirely as a byproduct from placer mining for gold. Its original source is thought to be the abundant ultra-basic rocks of northern California. Principal production has come from dredges operating in Amador, Butte, Merced, Sacramento, Stanislaus, Shasta, and Siskiyou Counties. Most of the dredges were shut down in October 1942 by War Production Board Order L-208, and much of their equipment including draglines, bulldozers, electric motors, rubber belts, pumps, generators, welding equipment, and other machines and parts were sent to the war industries. Since the restrictions were removed in July 1945, many of the dredges have been able to get needed equipment and to resume operations. Others are being assembled and will get into operation during 1947. Some are still idle because they have not been able to get draglines; others are waiting for costs of labor and supplies to go lower or the price of gold to be raised.

Table 30. Annual amount and value of platinum produced in California, 1887-1946

(Beginning in 1919, figures listed under "Ounces" represent fine ounces.) NOTE: Where necessary in order to conceal output of individual producers, production figures are omitted (1946).

Year	Ounces	Value	Year	Ounces	Value	Year	Ounces	Value
1887	416	$10,400	1908	300	$6,255	1929	212	$14,416
1888	100	400	1909	706	13,414	1930	217	11,700
1889	500	2,000	1910	337	8,386	1931	305	11,979
1890	500	2,000	1911	511	14,873	1932	278	8,142
1891	600	2,500	1912	603	19,731	1933	236	7,255
1892	100	500	1913	368	17,738	1934	424	14,884
1893	80	440	1914	463	14,816	1935	121	4,153
1894	75	517	1915	667	21,149	1936	1,000	40,669
1895	100	600	1916	886	42,642	1937	530	23,704
1896	150	900	1917	610	43,719	1938	1,069	35,150
1897	162	944	1918	571	42,788	1939	896	32,135
1898	150	900	1919	418	60,611	1940	1,358	62,419
1899	300	1,800	1920	477	68,977	1941	909	40,590
1900	300	1,800	1921	613	58,754	1942	941	41,927
1901	400	2,500	1922	795	90,288	1943	834	40,662
1902	250	3,200	1923	602	78,546	1944	0	0
1903	39	468	1924	273	36,452	1945	145	6,719
1904	70	1,052	1925	292	39,937	1946		
1905	123	1,849	1926	322	32,005			
1906	200	3,320	1927	139	10,749	Totals	24,446	$1,185,973
1907	91	1,647	1928	312	27,902			

Some platinum is probably lost because many operators feel that the effort necessary to recover it is unprofitable. Before the war a few firms made a business of collecting the black sands from the dredges and recovered the platinum metals in their plants on a percentage basis. This practice may be resumed as additional dredges get into operation, and production of the platinum metals may be increased.

Shipments of crude platinum metals reported from California sources during 1946 exceeded those of 1945, when 145 fine ounces of platinum group metals were shipped, of which 62 fine ounces were platinum, 32 fine ounces iridium, 29 fine ounces osmium, 10 fine ounces ruthenium, 11 fine ounces rhodium, and 1 fine ounce palladium. Much of the metal sold in 1945 and 1946 was mined several years earlier and held by the producers.

In 1944 no platinum metals were reported shipped from California mines for the first time since 1887, the year that production data on platinum were first collected in this state. This was due to the shut-down of the gold mines.

Present quotations from the Engineering and Mining Journal's *Metal and Mineral Markets* (August 7, 1947) are: platinum $56 a fine ounce; iridium $80 to $90 per fine ounce; osmium per fine ounce, $100 nominal; palladium per fine ounce, $24; ruthenium per fine ounce, $56; rhodium per fine ounce, $125.

QUICKSILVER

Bibliography: State Mineralogist Rept. 4, 5, 12-15 (inc.), 17-29 (inc.), 31, 33-37 (inc.), 39-41 (inc.); Bull. 27, 78, 91. U. S. Geol. Survey, Monograph XIII. U. S. Bur. Mines Tech. Paper 96, 227; Bull. 222, 335.

The State of California is foremost in the United States as a producer of quicksilver, accounting for about 70 percent of the total United States production. Falling prices are gradually causing the industry to decline. During World War II about 100 properties were producing, but this was reduced in 1946 to 32, of which only seven made an output of more than 300 flasks of 76 pounds each per year. The New Idria mine, San Benito County, is the largest producer.

The chief use of mercury is in the manufacture of chemicals and pharmaceuticals such as calomel and antiseptics. In the past an important use has been in fulminate, a highly explosive compound used in percussion caps and detonators. Substitutes have been developed that are safer and more reliable, however, and they are now preferred to mercury fulminate. As quicksilver, or mercury, is the only metal that is liquid at ordinary temperatures, it is very useful in many industrial and control instruments, such as gas-pressure gauges, tank gauges, gas-analysis apparatus, flow meters, heat-control devices, thermometers, and barometers. In the electrical industry it is used in mercury vapor lamps, fluorescent lamps, rectifiers, oscillators, and switches. A use that attracted considerable attention toward the end of the war was in a new type of dry-cell battery. Peacetime uses of this battery are expected to develop still further for such things as small radios and hearing-aids.

Table 31. Annual amount and value of quicksilver produced in California, 1850-1946

(Flasks, as tabulated herein, contained 76½ lbs. from 1850 to May 1904, inclusive; 75 lbs. from June 1904 to 1927, inclusive; 76 lbs. from 1928 to date. Sources of information used in preparing this table are: 1850-83, a table by J. B. Randol published in Report 4 of the State Mineralogist, p. 336; 1883-93, reports of the U. S. Geological Survey; 1894 to date, compiled by State Division of Mines.)

Year	Flasks	Value	Average price per flask	Year	Flasks	Value	Average price per flask
1850	7,723	$768,052	$99 45	1900	26,317	$1,182,786	$44 94
1851	27,779	1,859,248	66 93	1901	26,720	1,285,014	48 46
1852	20,000	1,166,600	58 33	1902	29,552	1,276,524	43 20
1853	22,284	1,235,648	55 45	1903	32,094	1,335,954	42 25
1854	30,004	1,663,722	55 45	1904	28,876	1,086,323	37 62
1855	33,000	1,767,150	53 55	1905	24,655	886,081	35 94
1856	30,000	1,549,500	51 65	1906	19,516	712,334	36 50
1857	28,204	1,374,381	48 73	1907	17,379	663,178	38 16
1858	31,000	1,482,730	47 83	1908	18,039	763,520	42 33
1859	13,000	820,690	63 13	1909	16,217	773,788	47 71
1860	10,000	535,500	53 55	1910	17,665	799,002	45 23
1861	35,000	1,471,750	42 05	1911	19,109	879,205	46 01
1862	42,000	1,526,700	36 35	1912	20,600	866,024	42 04
1863	40,531	1,705,544	42 08	1913	15,661	630,042	40 23
1864	47,489	2,179,745	45 90	1914	11,373	557,846	49 05
1865	53,000	2,432,700	45 90	1915	14,199	1,157,449	81 52
1866	46,550	2,473,202	53 13	1916	21,427	2,003,425	93 50
1867	47,000	2,157,300	45 90	1917	24,382	2,396,466	98 29
1868	47,728	2,190,715	45 90	1918	22,621	2,579,472	114 03
1869	33,811	1,551,925	45 90	1919	15,200	1,353,381	89 04
1870	30,077	1,725,818	57 38	1920	10,278	775,527	75 45
1871	31,686	1,999,387	63 10	1921	3,157	140,666	44 56
1872	31,621	2,084,773	65 93	1922	3,466	191,851	55 35
1873	27,642	2,220,482	80 33	1923	5,458	332,851	60 98
1874	27,756	2,919,376	105 18	1924	7,948	543,080	68 33
1875	50,250	4,228,538	84 15	1925	7,683	621,831	80 81
1876	75,074	3,303,256	44 00	1926	5,892	516,382	87 64
1877	79,396	2,961,471	37 30	1927	6,488	714,418	111 67
1878	63,880	2,101,652	32 90	1928	7,107	844,649	118 84
1879	73,684	2,194,674	29 85	1929	10,152	1,195,705	117 78
1880	59,926	1,857,706	31 00	1930	11,374	1,255,257	110 36
1881	60,851	1,815,185	29 83	1931	13,478	1,121,624	83 22
1882	52,732	1,488,624	28 23	1932	5,349	279,780	52 30
1883	46,725	1,343,344	28 75	1933	4,102	229,472	55 94
1884	31,913	973,347	30 50	1934	7,946	534,135	67 22
1885	32,073	986,245	30 75	1935	9,353	628,590	67 23
1886	29,981	1,064,326	35 50	1936	8,758	671,055	76 62
1887	33,760	1,430,749	42 38	1937	9,995	837,789	83 82
1888	33,250	1,413,125	42 50	1938	12,171	846,497	69 55
1889	26,464	1,190,880	45 00	1939	11,201	1,105,563	98 43
1890	22,926	1,203,615	52 50	1940	18,907	3,209,754	169 77
1891	22,904	1,036,406	45 25	1941	25,612	4,509,041	176 03
1892	27,993	1,139,595	40 71	1942	30,087	5,553,357	184 58
1893	30,164	1,108,527	36 75	1943	33,948	6,177,159	181 96
1894	30,416	934,000	30 70	1944	28,097	3,178,969	113 14
1895	36,104	1,337,131	37 04	1945	21,063	2,697,535	128 08
1896	30,765	1,075,449	34 96	1946	17,804	1,648,758	92 61
1897	26,691	993,445	37 23				
1898	31,092	1,188,626	38 23	Totals	2,591,829	$146,187,008	
1899	29,454	1,405,045	47 70				

Spanish and Italian producers control the world market for mercury through a cartel. United States tariff of $19.00 per flask is inadequate to afford much protection from this combination, because European producers are able to pay the tariff and still undersell domestic producers by a large amount. At present costs of labor and materials, a price of $125.00 per flask is needed to keep California's quicksilver industry in a healthy condition, with proper exploration and development of ore reserves. In mid-1947 quicksilver is quoted at $84.00 to $87.00 per 76-pound flask; hence, further curtailment of production must be expected.

The quicksilver reported produced in California during 1946 totaled 17,804 flasks (76 pounds) valued at $1,648,758 and came from mines in Contra Costa, Del Norte, Fresno, Kings, Lake, Napa, San Benito, San Luis Obispo, Santa Barbara, Santa Clara, Sonoma, Trinity, and Yolo Counties. The 1946 output showed a decrease in both amount and value compared with that of 1945 when 21,063 flasks worth $2,697,835 was reported.

Total amount and value of the quicksilver production of California, as given in available records, are shown in table 31. Though the New Almaden mine in Santa Clara County was first worked in 1824, and was in practically continuous operation from 1846 to 1921 (the yield being small the first 2 years), no data are available on the output earlier than 1850.

SILVER

Bibliography: State Mineralogist Rept. 4, 8, 12-39 (inc.), 41; Bull. 67, 91, 108. Min. and Sci. Press, March 1, 1919.

Few mines in California have been operated primarily for the production of silver, but this metal is recovered as a by-product of gold mining, of zinc-lead mining, and of copper mining. In 1940 the principal producer of silver was the Cactus Queen mine in Kern County, a gold-silver mine, and the second largest producer was the Lava Cap mine in Nevada County, a gold mine. Recently the largest silver producer has been the Darwin group in Inyo County, a zinc-lead mine operated by Anaconda Copper Mining Company.

The output of silver in California during 1946 amounted to 1,342,651 fine ounces valued at $1,084,862, being an increase in both amount and value as compared with 986,798 fine ounces worth $701,723 in 1945. Of the 1946 yield 19,821 fine ounces worth $16,015 came from placer operations, chiefly the gold dredges; the remaining 1,322,830 fine ounces

Table 32. Mine production of silver during 1946, by county

County	Fine ounces	Value	County	Fine ounces	Value	County	Fine ounces	Value
Amador	15,626	$12,626	Mariposa	1,111	$898	San Francisco	3	$2
Butte	1,623	1,311	Merced	341	276	San Joaquin	1,361	1,100
Calaveras	111,370	89,987	Mono	984	795	Shasta	100,143	80,916
Del Norte	21	17	Nevada	12,698	10,260	Sierra	2,140	1,729
El Dorado	1,318	1,065	Orange	2,785	2,250	Siskiyou	1,208	976
Fresno	42	34	Placer	341	276	Stanislaus	1,824	1,474
Humboldt	8	6	Plumas	71	57	Trinity	1,428	1,154
Imperial	62	50	Riverside	92	74	Tuolumne	1,095	885
Inyo	970,167	783,895	Sacramento	5,354	4,326	Yuba	3,371	2,724
Kern	8,629	6,972	San Bernardino	97,411	78,708	Totals	1,342,651	$1,084,862
Los Angeles	5	4						
Madera	19	15						

Table 33. Ten leading silver-producing mines in California in 1946 in order of output

Rank	Mine	District	County	Rank in 1945	Operator	Source of silver
1	Darwin group	Coso	Inyo	1	Anaconda Copper Mining Co.	Lead ore
2	Penn	Campo Seco	Calaveras	4	Shawmut Copper Mine Co.	Zinc ore
3	Hornet	Flat Creek	Shasta	3	The Mountain Copper Co., Ltd.	Zinc-copper ore
4	Columbia No. 2	Resting Springs	Inyo	5	Finley Co.	Lead ore
5	Kelly and Juanita	Randsburg	San Bernardino	No prod.	F. W. Royer	Gold-silver ore
6	Carbonate King	Clark Mountain	San Bernardino	No prod.	Crystal Cave Mining Co.	Zinc ore
7	Mohawk	Clark Mountain	San Bernardino	7	Dunton-Ray & Greenwood	Lead and lead-zinc ore
8	Modoc	Coso	Inyo	6	L. D. Foreman & Co.	Lead ore
9	Pine Creek	Bishop Creek	Inyo	No prod.	U. S. Vanadium Corporation	Tungsten ore
10	Newton	Ione	Amador	9	Pacific Mining Co.	Copper ore

Table 34. Annual amount and value of silver produced in California, 1880-1946

(No reliable production records were kept prior to 1880. In the Division of Mines statistical bulletins issued prior to Bulletin 100 [1927], values shown for the period 1880-1904, inclusive, were taken from reports of the Director of the Mint, wherein figures for 1880-96, inclusive, were based on coinage value of $1.2929 per fine ounce. These figures have been recalculated herein to commercial value on the basis of a price table prepared by H. D. McCaskey in Mineral Resources, U. S., 1913, pt. 1, p. 847. Figures from 1905-46 have been supplied by the U. S. Geological Survey and U. S. Bureau of Mines. Figures listed under "Average price per oz.", 1934-45, inclusive, represent average price applied to newly mined silver within the United States.)

Year	Fine oz.	Value	Average price per oz.	Year	Fine oz.	Value	Average price per oz.
1880	882,169	$1,014,494	$1 15	1914	1,471,859	$813,938	$0 553
1881	580,091	655,503	1 13	1915	1,678,756	851,129	507
1882	653,569	745,069	1 14	1916	2,564,354	1,687,345	658
1883	1,129,244	1,253,461	1 11	1917	1,775,431	1,462,955	824
1884	3,236,987	3,593,056	1 11	1918	1,427,711	1,427,711	1 00
1885	1,968,260	2,125,298	1 07	1919	1,107,189	1,240,051	1 12
1886	1,245,747	1,233,290	99	1920	1,706,327	1,859,896	1 09
1887	1,262,282	1,237,036	98	1921	3,629,223	3,629,223	1 00
1888	1,314,374	1,235,932	94	1922	3,100,065	3,109,065	1 00
1889	823,947	774,510	94	1923	3,559,443	3,629,223	82
1890	820,336	861,353	1 05	1924	3,555,133	2,381,952	67
1891	737,224	729,852	99	1925	3,054,416	2,119,765	694
1892	358,575	311,960	87	1926	2,022,460	1,262,015	624
1893	415,468	324,065	78	1927	1,620,242	918,677	567
1894	229,896	144,834	63	1928	1,478,711	865,081	585
1895	463,911	301,542	65	1929	1,176,895	627,285	533
1896	326,757	222,195	68	1930	1,622,803	624,779	385
1897	754,648	452,789	60	1931	867,818	251,667	290
1898	701,788	414,055	59	1932	493,533	139,176	282
1899	855,869	513,521	60	1933	402,591	140,907	350
1900	1,168,157	724,257	62	1934	844,413	545,883	644
1901	950,831	570,499	60	1935	1,191,112	856,112	719
1902	1,163,041	616,412	53	1936	2,103,799	1,629,392	775
1903	958,230	517,444	54	1937	2,888,265	2,234,073	774
1904	1,441,259	835,929	58	1938	2,590,804	1,674,863	646
1905	1,076,174	650,009	61	1939	2,599,139	1,764,264	678
1906	1,220,641	817,830	68	1940	2,359,776	1,678,063	711
1907	1,138,856	751,646	66	1941	2,154,188	1,531,867	711
1908	1,647,278	873,057	53	1942	1,450,440	1,031,424	711
1909	2,098,253	1,091,092	52	1943	609,075	433,120	711
1910	1,840,085	993,646	54	1944	778,936	553,910	711
1911	1,270,445	673,336	53	1945	986,798	701,723	711
1912	1,300,136	799,584	61	1946	1,342,651	1,084,862	808
1913	1,378,399	832,553	60				
				Totals	97,627,783	$72,942,075	

worth $1,068,847 came from the lode mines, chiefly from the lead mines and the copper-zinc mines. The average price paid for newly mined silver during 1946 was 80.8 cents per fine ounce as compared with 71.11 cents per fine ounce from 1940 to 1945; 67.80 cents per fine ounce in 1939; 64.60 cents per fine ounce in 1938; 77.35 cents per fine ounce in 1937; and 77.45 cents per fine ounce in 1936.

The following paragraphs and table 33 are quoted from Minerals Yearbook for 1946, *Gold, Silver, Copper, Lead, and Zinc in California,* by courtesy of Alfred L. Ransome, United States Bureau of Mines.

> "*Silver.* The 10 leading silver-producing mines listed in table 33 yielded 95 percent of the state total recoverable silver in 1946, and the 3 leading mines yielded 80 percent. Of the ten leading silver-producing mines, eight derived their silver from argentiferous base metal ores, one from gold-silver ore, and one from tungsten ore.
>
> "Silver production by months in 1946 * * * shows a sharp drop in February followed by a period of moderate fluctuation through August at an average level of 83,300 ounces. Output in September increased markedly to 132,450 ounces followed by a continuing advance during the last quarter which showed indications of leveling off by the end of the year. The entire background for the trend in production is closely allied to the operation of the Darwin group of mines, Coso district, Inyo County, operated by the Anaconda Copper Mining Company."

TIN

Bibliography: State Mineralogist Rept. 15, 17, 18, 25, 31, 34, 35-37 (inc.), 41; Bull. 67, 91.

During 1946 no tin ore was reported shipped from California. In 1944 a small shipment of tin ore was reported from Kern County which was shipped to the stockpile of the Metals Reserve Company.

In 1940 some development work was done at the Apex mine 9 miles north of Cima, San Bernardino County, but no shipment has been reported to date. Here the tin ore occurs in small kidneys along the talcose slip in dolomitic limestone.

In 1928-29 a small amount of tin was produced from California ore and considerable development work was done at the Temescal mine in Riverside County near Corona. An output from the district during 1891-92 is shown in table 35. Small quantities of stream tin have been found in some of the placer workings in northern California, but never in paying amounts.

Two occurrences have been noted in northern San Diego County. Crystals of cassiterite were found there, associated with blue tourmaline crystals, amblygonite, and beryl. No commercial quantity has been developed, only small pockets having been taken out.

Table 35. Annual poundage and value of tin produced in California, 1891-1946

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1928-29), or omitted (1944).

Year	Pounds	Value	Year	Pounds	Value
1891	125,289	$27,564	1930-43	0	$0
1892	126,000	32,400	1944		
1893-1927	0	0	1945-46	0	0
1928-29	1,200	580			
			Totals	252,489	$60,544

TITANIUM

Bibliography: State Mineralogist Rept. 23, 34.

The United States production of ilmenite in 1946 was 308,516 short tons, average TiO_2 content 46 percent, sold at an average price of $24 per short ton f.o.b. Atlantic seaboard points. The New York price for rutile, base 60 percent TiO_2, is $28 to $30 per short ton. In California, where most of the ilmenite produced is used for roofing granules rather than for the production of titanium dioxide, ilmenite concentrates are sold at $16 to $20 per short ton, base 45 percent TiO_2, f.o.b. Los Angeles or San Francisco Bay points.

Ilmenite sands were shipped during 1946 from a new plant in Sand Canyon near Saugus in Los Angeles County for use on roofing paper. In 1945 no titanium minerals were reported shipped from California sources, but in 1944 small shipments of titanium ore (ilmenite) were made from material recovered from beach sand at Hermosa Beach, Los Angeles County.

All titanium ore mined in this state came from Los Angeles County and was produced either from the beach black sands which contained approximately 20 percent titaniferous iron and magnetite, the gangue being silica and several silicates, or from a lode deposit in the San Gabriel Mountains.

The market price of titanium minerals varies with the titanium oxide they contain. Present (July 17, 1947) quotations are: rutile 94 percent TiO_2 at 8 cents to 10 cents a pound, ilmenite 57 to 60 percent TiO_2 at $18.50 to $19.50 a gross ton, all prices Atlantic seaboard.

The metal is used in several different alloys with iron, copper, and aluminum and for green and white pigments, the only colors of titanium pigments now in common use. It is also used in dyes, rubber, as a porcelain glaze, in glass, and cement made from high-titanium iron slags. This cement is resistant to the action of acids.

Table 36. Annual tonnage and value of titanium produced in California, 1927-46

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1927-28, etc.), or omitted (1946).

Year	Tons	Value	Year	Tons	Value
1927-28	10,013	$150,195	1943-44	250	$3,400
1929-38	0	0	1945	0	0
1939-40	160	1,800	1946		
1941-42	295	3,685			
			Totals	10,718	$159,080

TUNGSTEN

Bibliography: State Mineralogist Rept. 15, 17, 18, 22, 24-28 (inc.), 30, 34-39 (inc.), 41; Bull. 38, 67, 91, 95. U. S. Geol. Survey Bull. 652. Colorado Sci. Soc. vol. 11. South Dakota School of Mines, Bull. 12.

There are hundreds of deposits of scheelite in California, and some of them represent the large low-grade reserves of tungsten in the United States.

The largest producer in California, the U. S. Vanadium Corporation, is expected to resume milling operations at its Pine Creek mine in Inyo County in July 1947. Recently their activities have been confined to

Table 37. Annual tonnage and value of tungsten produced in California, 1905-46

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1927-28, etc.).

Year	Tons at 60% WO_3	Value	Average unit WO_3 value	Year	Tons at 60% WO_3	Value	Average unit WO_3 value
1905	57	$18,800	$5 50	1927-28	649	$429,237	$11 03
1906	485	189,100	6 50	1929	150	106,280	11 81
1907	287	120,587	7 00	1930-31	120	82,582	11 47
1908	105	37,750	5 99	1932	26	9,509	6 10
1909	577	190,500	6 50	1933	148	76,605	8 63
1910	457	208,245	7 60	1934	261	224,417	14 33
1911	387	127,706	5 50	1935	218	194,542	14 87
1912	572	206,000	6 00	1936	236	210,819	14 89
1913	559	234,673	7 00	1937	611	782,187	21 34
1914	420	180,575	7 17	1938	732	786,860	17 92
1915	962	1,005,467	17 42	1939	1,235	1,153,735	15 47
1916	2,270	4,571,521	33 57	1940	1,784	2,267,135	21 15
1917	2,466	3,079,013	20 81	1941	2,860	4,080,628	23 77
1918	1,982	2,832,222	24 82	1942	3,853	5,586,770	24 16
1919	214	219,316	17 08	1943	4,235	5,910,745	23 26
1920-22	0	0		1944	3,399	4,835,810	23 71
1923	34	19,126	8 17	1945	1,192	1,587,951	22 21
1924	781	446,009	9 52	1946	1,709	2,072,680	20 22
1925	573	348,475	10 14				
1926	441	316,560	11 96	Totals	37,047	$44,750,137	

underground development. The capacity of this plant is 1400 tons of ore per day.

At the Tungstar mine on Mount Tom, west of Pine Creek, about 3½ miles southeast of the Pine Creek mine, development work is being done preparatory to reopening the mill. El Diablo Mining Company is developing a deposit on Pine Creek above the mill of U. S. Vanadium Corporation, and although hampered by snow, may be expected to resume operation of its mill in the next few months. Hoeffling Brothers are working placers east of the Union mine at Atolia, recovering both gold and tungsten.

Although the price of tungsten concentrates is $28.00 to $30.00 per unit, there is little production in the state at this time (June 1947). The above price apparently is a foreign market price; Great Britain and Russia entered the market the first of the year, and more recently France has started buying. This means that the domestic price is nearer $26.00 per unit, there being a $4.00 differential. Action yet to be taken on foreign trade agreements may have a bearing on these prices.

Even though the production of tungsten in California is now very small the outlook is not gloomy. The larger producers are preparing to resume operations and the present price is sufficient to attract other operators to this field.

High-grade tungsten ore and concentrates reported shipped in California during 1946 amounted to a total of 102,513 units of WO_3, or the equivalent of 1,709 tons of 60 percent WO_3 concentrates. These had a value of $2,072,680 at the mine, and came from 16 properties in Fresno, Kern, Inyo, Mono, San Bernardino, and Tulare Counties. In addition, two properties in Inyo County, and one each in Alpine and Kern Counties reported mining tungsten ore but not concentrating or making shipments during the year. The 1946 output showed an increase in both amount and value as compared with 71,511 units of WO_3 worth $1,587,951 in 1945. The average received by California miners f.o.b. property in 1946 was $20.22 per unit WO_3 as compared with $22.21 per unit WO_3 in 1945; $23.71 per unit WO_3 in 1944; $23.26 per unit WO_3 in 1943; $24.16 per unit WO_3 in 1942; $23.77 per unit of WO_3 in 1941; and $21.15 per unit of WO_3 in 1940.

Tungsten ores have been produced in California principally in the Atolia-Randsburg district in San Bernardino and Kern Counties, and the Bishop district in Inyo County; smaller amounts have come from near Posey (Jack Ranch), Tulare County; Benton, Mono County; the Kings River district in Fresno County; eastern San Bernardino County near Goffs and Ivanpah; the Grass Valley district in Nevada County; the Darwin district in Inyo County; the Kernville and Weldon districts in Kern County; Topaz Lake district in Mono County; and near Warm Springs, San Diego County. Also there are occurrences of tungsten ores in Alpine, Calaveras, El Dorado, Mariposa, Madera, Plumas, Riverside, Shasta, and Tuolumne Counties, of which serveral are now in production. In the last 10 years there have been more new tungsten deposits discovered than any other type of mineral deposit in this state. Nearly all the ore mined in California has been scheelite (calcium tungstate), although wolframite (iron-manganese tungstate), hübnerite (manganese tungstate), and other tungsten minerals are found in small amounts, in part associated with the scheelite.

VANADIUM

Bibliography: State Mineralogist Rept. 15, 26; Bull. 67, 91. Colorado Sci. Soc. Proc., vol. 11, 36. U. S. Bur. Mines, Bull. 104.

No commercial production of vanadium has yet been made in California. Occurrences of this metal have been found at Camp Signal, near Goffs, in San Bernardino County, and two companies at one time did considerable development work in the endeavor to open up paying quantities. Some ore carrying lead vanadate has been developed in the 29 Palms, or Washington district, on the line between Riverside and San Bernardino Counties, but no shipments have been reported.

The principal use of vanadium is as an alloy in steels, especially in tool steel, and in those varieties where resistance to repeated strains is required. Present (August 7, 1947) New York quotations for ferrovanadium are $2.70 to $2.90 per pound of vanadium f.o.b. works, and vanadium ore 27½ cents per pound V_2O_5 contained f.o.b. shipping point.

ZINC

Bibliography: State Mineralogist Rept. 14, 15, 17, 18, 20-24 (inc.), 26, 27, 30, 33-35 (inc.), 39, 41; Bull. 38, 67, 91.

California zinc minerals are closely associated with copper deposits in Shasta and Calaveras Counties, and with lead deposits in Inyo County. Zinc has been produced recently in Amador, Butte, Mariposa, Orange, San Bernardino, and Siskiyou Counties also. Zinc and copper minerals are so intimately associated in Shasta County ores that deposits containing 16 percent zinc, 2 percent copper, and 5 ounces of silver per ton were left as unprofitable to mine about 25 years ago. Premiums paid until July 1, 1947, for zinc and associated metals, and particularly advances in the technique of selective flotation, made it profitable to mine these ores, and zinc production has been more than a million pounds each year since 1942. The present high cost of mining, and the uncertainty that premium payments would be continued beyond June 30 have discouraged development, and most deposits have been mined without development of reserves.

Geologic knowledge concerning the character of the Shasta County deposits and their structural control, together with their geophysical characteristics, promise to disclose zones where zinc ore bodies may be confidently sought by core drilling. Shasta County properties are being developed as probable producers of both zinc and copper.

Zinc ores now mined in California must be sent to Utah, Montana, or Idaho for smelting and refining. Production of zinc reached a high of 19,340,732 pounds worth $2,224,184 in 1945, declined to 14,639,804 pounds worth $1,786,056 in 1946, and is declining further in 1947.

The zinc ores in Shasta and Calaveras Counties are associated with copper; those of Inyo, Los Angeles, Orange, San Bernardino, and Tulare are associated principally with lead-silver and zinc-silver ores.

Table 38. Production of zinc during 1946, by county

County	Pounds	Value	County	Pounds	Value
Butte	67,073	$8,183	Orange	28,311	$3,454
Calaveras	6,601,266	805,354	San Bernardino	1,240,776	151,375
Inyo	2,279,963	278,155	Shasta	3,851,278	469,856
Mariposa	571,137	69,679	Totals	14,639,804	$1,786,056

Table 39. Annual poundage and value of zinc produced in California, 1906-46

Year	Pounds	Value	Year	Pounds	Value	Year	Pounds	Value
1906	206,000	$12,566	1920	1,188,009	$96,229	1935	328,013	$14,432
1907	177,759	10,598	1921	846,184	42,309	1936	29,740	1,487
1908	54,000	3,544	1922	3,034,430	172,963	1937	39,643	2,577
1909	0	0	1923	0	0	1938	17,554	843
1910	0	0	1924	3,060,000	198,900	1939	16,390	852
1911	2,679,842	152,751	1925	11,546,602	877,542	1940	182,088	11,472
1912	4,331,391	298,866	1926	20,447,559	1,533,568	1941	880,612	66,046
1913	1,157,947	64,845	1927	8,625,004	552,000	1942	1,275,906	118,659
1914	399,641	20,381	1928	0	0	1943	5,170,627	558,427
1915	13,043,411	1,617,383	1929-30	0	0	1944	16,456,103	1,875,996
1916	15,950,565	2,137,375	1931	149,865	5,314	1945	19,340,732	2,224,184
1917	11,854,804	1,209,190	1932	0	0	1946	14,639,804	1,786,056
1918	5,565,516	506,466	1933	290,222	12,189			
1919	1,384,192	101,046	1934	721,719	31,034	Totals	165,091,874	$16,318,090

A, GRAU PIT

McLaughlin and Applegarth chromite deposit, 35 miles southwest of Red Bluff, Tehama County. *Photo by Walter W. Bradley. Reprinted from California Journal of Mines and Geology, July 1946, p. 187.*

B, TAPPING THE BLAST FURNACE

At Fontana plant of Kaiser Company, San Bernardino County. *Photo by Walter W. Bradley. Reprinted from California Journal of Mines and Geology, April 1945, pl. 22B.*

A, U. S. GYPSUM COMPANY PLANT AT MIDLAND, RIVERSIDE COUNTY

Photo by W. B. Tucker, Reprinted from California Journal of Mines and Geology, July 1945, pl. 30.

B, LIMESTONE QUARRY

Calaveras Cement Company, near San Andreas, Calaveras County.
Photo by Walter W. Bradley.

A, PATIO TILE

At Kraftile plant, Niles, Alameda County. *Photo by Walter W. Bradley.*

B, PLANT OF THE AMERICAN POTASH AND CHEMICAL CORPORATION

At Searles Lake, San Bernardino County. *Photo by Walter W. Bradley. Reprinted from California Journal of Mines and Geology, October 1946, pl. 49B.*

A, PACIFIC COAST AGGREGATES INC.

Property at Lapis; removal of dune sands. *Photo by Lauren A. Wright. Reprinted from California Journal of Mines and Geology, January 1948, pl. 4A.*

B, ANTIOCH-MARCHIO SILICA-SAND EXCAVATION

Photo by Lauren A. Wright. Reprinted from California Journal of Mines and Geology, January 1948, pl. 2A.

CHAPTER THREE

INDUSTRIAL NON-METALLIC MATERIALS

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INTRODUCTION

Bibliography: State Mineralogist Reports 12-41 (inc.) ; Bull. 38.

The following mineral substances have been arbitrarily arranged under the general heading *Industrial Nonmetallic Materials* as distinguished from fuels, metals, and salines which have a clearly defined classification.

These materials, many of which are mineral earths, are produced on a comparatively small scale. There are great possibilities for development of several of these. Increased accessibility and the steadily growing demand brought about by establishment and expansion of chemical and manufacturing plants in the West, make the future of this branch of the mineral industry in California very bright. There is not a county in the state that cannot contribute to this group's output. In 1944-46 all counties contributed but one, namely, Kings.

This group as a whole showed an increase in total value from $59,695,692 in 1945 to $80,568,182 in 1946. Nearly all materials showed a greater yield and a higher total value for the year 1946 than for the previous year, with the exception of bentonite, dolomite, lithia minerals, mineral paint, strontium minerals, and the sillimanite group.

Table 40. Comparison of 1945 and 1946 output of industrial nonmetallic materials in California

Substance	1945		1946		Value of increase(+) or decrease(—)
	Amount	Value	Amount	Value	
Brick and hollow tile		$3,523,661		$5,565,075	$2,041,414+
Cement	15,922,772 bbls.	23,469,027	19,546,336 bbls.	32,403,081	8,934,054+
Clay (pottery)	497,586 tons	1,345,966	604,140 tons	1,606,256	260,290+
Granite		220,411		275,367	54,956+
Gypsum	442,133 tons	954,696	618,007 tons	1,431,884	477,188+
Limestone	532,480 tons	1,626,844	767,170 tons	1,974,479	347,635+
Mineral water	26,502,875 gals.	798,430	33,397,902 gals	1,132,399	333,969+
Pumice and volcanic ash	89,209 tons	461,022	109,191 tons	540,811	79,789+
Sandstone		7,498	2,286 tons	25,764	18,266+
Silica (quartz and glass sand)	581,725 tons	1,309,564	594,155 tons	1,408,553	98,989+
Soapstone and talc	65,202 tons	922,682	74,146 tons	945,294	22,612+
Stone miscellaneous	29,449,484 tons	20,207,351	41,610,212 tons	27,671,788	7,464,437+
Unapportioned	[b]	4,848,540	[a]	5,587,431	738,891+
Total values		$59,695,692		$80,568,182	
Net increase					$20,872,490+

[a] Includes asbestos, barite, bentonite, bituminous rock, carbon dioxide, diatomite, dolomite, feldspar, gems, lithia, marble, mica (sericite), mineral paint, pyrite, serpentine, sillimanite group (kyanite), slate, strontium, sulphur, and tube-mill pebbles.

[b] Includes asbestos, barite, bentonite, bituminous rock, carbon dioxide, diatomite, dolomite, feldspar, gem materials, garnets (abrasive), lithia, magnesite, mica, mineral paint, pyrite, sillimanite group, slate, strontium minerals, and grinding-mill pebbles.

ASPHALT

Bibliography: State Mineralogist Rept. 7, 10, 12-15 (inc.), 17, 18, 38; Bull. 16, 32, 63, 67, 69, 91, 118.

Asphalt was for a number of years accounted for in the statistical reports by the State Mining Bureau, because in the early days of the oil industry considerable asphalt was produced from outcroppings of oil sand, separate from the production of oil itself. However, at the present time most of the asphalt comes from the oil refineries, which

produce a better and more uniform grade; hence, its value is not now included in the mineral total, as to do so would be in part a duplication of the crude petroleum figures. Such natural asphalt as is at present mined is in the form of bituminous rock, and is recorded under that designation.

ASBESTOS

Bibliography: State Mineralogist Rept. 12-19 (inc.), 22-27 (inc.), 29, 31, 32, 34-37 (inc.), 39-41 (inc.); Bull. 38, 91. Canadian Dept. Mines, Mines Branch Bull. 69.

Although minute stringers and veinlets of chrysotile asbestos occur throughout the serpentines of northern California, production of short-fiber chrysotile asbestos has been very limited in this state. Needs for this type of asbestos—the variety that can be woven into fabrics such as asbestos curtains, asbestos clothing, and brake linings—are supplied the United States largely by Canada. The largest tonnages find their way into the building trades for such manufactured products as sheeting, wall board, shingles, pipe covering, and boiler covering. California is not producing this type of asbestos at the present time, but sales of short-fiber chrysotile asbestos were made from a property in Napa County in 1945.

Table 41. Annual tonnage and value of asbestos produced in California, 1887-1946

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2- or 3-year period (1919-20, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1887	30	$1,800	1904	10	$162	1922	50	$1,800
1888	30	1,800	1905	112	2,625	1923	20	200
1889	30	1,800	1906	70	3,500	1924	70	4,750
1890	71	4,260	1907	70	3,500	1925-26	25	1,650
1891	66	3,960	1908	70	6,100	1927-28	13	1,160
1892	30	1,830	1909	65	6,500	1929-30	219	6,175
1893	50	2,500	1910	200	20,000	1931	0	0
1894	50	2,250	1911	125	500	1932-34	309	3,274
1895	25	1,000	1912	90	2,700	1935	0	0
1896	0	0	1913	47	1,175	1936	0	0
1897	0	0	1914	51	1,530	1941	16	2,867
1898	10	200	1915	143	2,860	1942	4	836
1899	30	750	1916	145	2,380	1943-44	723	15,000
1900	50	1,250	1917	136	10,225	1945-46	37	3,605
1901	110	4,400	1918	229	9,903			
1902	0	0	1919-20	131	6,240	Totals	4,172	$168,292
1903	0	0	1921	410	19,275			

Though the fibers of amphibole asbestos are too brittle for weaving into fabrics, they can be used industrially since they are resistant to acid. A small tonnage of amphibole asbestos is in constant demand for filtering acids. Properties in Shasta and Placer Counties are producing tremolite asbestos.

BARITE

Bibliography: State Mineralogist Rept. 12, 14, 15, 17, 21-28 (inc.), 34, 35, 37, 39; Bull. 38, 87. U. S. Bur. Mines, Inf. Circ. 6221, 6223.

California has a number of important barite deposits and is an important producer. Barium pigments manufactured in California are made from raw material imported from Nevada, but most of the barite mineral produced in California finds its way into drilling muds. At the present time the principal production is coming from Mariposa and

Plumas Counties. Another deposit is being developed in Tulare County, and reserves probably exist in both Nevada and Shasta Counties.

Barite is a mineral of high specific gravity that is used mainly for giving weight to mud in drilling oil wells. The mud controls the pressure of gas and otherwise facilitates drilling.

Barite that is white when finely pulverized is used as a pigment, but most of the barite so used is given chemical treatment to convert it into lithopone. The mineral is also used in the glass and rubber industries and for the manufacture of a number of barium chemicals. A large plant at Modesto manufactures such chemicals from raw barite produced in California.

The tonnage of barite produced in California during 1946 was less than that mined in 1945, but the total value of production was higher. This material came from a single property each in Mariposa and Plumas Counties. In 1945 a mine in Nevada County also produced and shipped barite.

The 1945 output was the largest annual yield of barite so far reported in this state. The 1944-45 shipments totaled 67,783 net tons worth $409,825.

Barite's largest use in the United States is in the manufacture of lithopone, which is a chemically prepared white pigment containing approximately 70 percent barium sulphate and 30 percent zinc sulphide. This is one of the principal constituents of flat wall paints. Other important uses for barite, after washing and grinding, are as an inert pigment and filler in paint, paper, linoleums, oilcloth and rubber manufacture, and in the preparation of a number of chemicals including barium binoxide, carbonate, chloride, nitrate, the sulphate precipitated, or blanc fixe, and in medicine. The deposit at El Portal, in Mariposa County, has given the largest commercial production to date, in part witherite (barium carbonate, $BaCO_3$). The carbonate is especially desirable, as it is a simpler and hence a cheaper source for preparation of barium chemicals, notably the nitrate, which is used in priming mixture for incendiary bombs.

Most barite production in California is captive; manufacturers of processed products using barite lease or own their own deposits. Prices paid for crude barite f.o.b. California points are based on individual contractual schedules, but average between $8.00 and $10.00 per short ton, depending on the analysis of the crude material, freight rates, and other considerations. For chemical use, the crude barite should contain not less

Table 42. Annual tonnage and value of barite produced in California, 1910-46

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1936-37, etc.) or omitted (1946).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1910	860	$5,640	1922	3,370	$18,925	1933	8,405	$49,595
1911	309	2,207	1923	2,925	16,058	1934	21,769	125,514
1912	564	2,812	1924	0	0	1935	22,979	133,810
1913	1,600	3,680	1925	0	0	1936-37	41,882	245,392
1914	2,000	3,000	1926	4,798	38,165	1938-39	66,228	396,218
1915	410	620	1927	17,993	90,617	1940-41	57,728	377,229
1916	1,606	5,516	1928	13,406	55,888	1942-43	53,625	311,910
1917	4,420	25,633	1929	26,796	168,829	1944-45	67,783	409,825
1918	100	1,500	1930	19,783	133,107	1946		
1919	1,501	18,065	1931	27,832	156,647			
1920	3,029	20,795	1932	8,507	49,409	Totals	483,109	$2,871,415
1921	901	4,809						

than 90 to 92 percent barium sulfate, and not more than 0.3 percent ferric oxide. For use in drilling muds, the principal specification is high specific gravity: over 4.1 and preferably higher than 4.2. A hard crystalline barite is preferred for this use. Color is not important in the crude barite ground for drilling mud. Present prices paid by consumers for ground barite used as drilling mud are as follows: f.o.b. warehouse as noted, 24-hour delivery service, in short tons, bagged; prices subject to change without notice:

Castaic Junction	$31.49
Coalinga	28.22
Long Beach	32.12
Los Angeles	31.07
Merced	25.05
Rio Vista	28.01
Shafter	28.22
Ventura	31.49

The foregoing prices are for minus 325-mesh ground barite of not less than 4.1 specific gravity. Usual terms of 1 percent 10 days, net 30 days, apply to purchases.

Several commercial grinding mills in the state are equipped to grind barite on a custom basis. Usual charge for grinding to 93 percent minus 325-mesh varies from $5.00 to $7.50 per ton, depending on loading, bagging, and other services rendered, and on the moisture content of the crude material. A weight loss of from 2 to 6 percent takes place in grinding; the higher the moisture content of the crude barite, the higher the loss.

BENTONITE AND FULLERS EARTH

Bibliography: State Mineralogist Rept. 14, 17, 18, 21, 23, 25-27 (inc.), 34, 36-37 (inc.); Bull. 83, 91. U. S. Bur. Mines, Bull. 71, Tech. Paper 609.

Bentonite is produced chiefly from large deposits in San Bernardino, Inyo, Kern, and San Diego Counties. The principal production in southern California is for drilling mud used in the petroleum industry.

From 1935-46, production averaged about 11,000 tons per year. With increase in the amount of drilling in the various oil fields in California, an increased production of bentonite should result. Other uses are increasing with the industrial development of southern California.

Principal producers are Baroid Sales Division, National Lead Company; Kennedy Minerals Company; Sierra Talc Company; Pacific bentonite mine; Standard Oil Company of California; F. C. Schundler & Company.

The bentonite clay shipped during 1946 came from properties in Inyo, Kern, and San Bernardino Counties; in 1945 it came from properties in Inyo and San Bernardino Counties. The total bentonite reported shipped for the years 1945 and 1946 was 26,860 tons worth $267,524.

Bentonite is the name commonly applied to the clays of the montmorillonite and halloysite group (rock soap).

Fullers earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, nonplastic, white and gray to dark green in color; some varieties disintegrate in water. Production has come mainly from Calaveras and Solano Counties; there are also deposits in Riverside, Fresno, Inyo, and Kern Counties.

Table 43. Annual tonnage and value of bentonite and fullers earth produced in California, 1899-1946

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1945-46).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1899	620	$12,400	1916	110	$550	1932	4,295	$57,670
1900	500	3,750	1917	220	2,180	1933	4,605	60,621
1901	1,000	19,506	1918	37	333	1934	6,168	69,325
1902	987	19,246	1919	385	3,810	1935	10,204	68,372
1903	250	4,750	1920	600	6,000	1936	10,185	165,131
1904	500	9,500	1921	1,185	8,295	1937	8,425	140,261
1905	1,344	38,000	1922	6,606	48,756	1938	9,374	113,164
1906	440	10,500	1923	3,650	55,125	1939	11,284	138,864
1907	100	1,000	1924	5,290	67,295	1940	10,360	174,002
1908	50	1,000	1925	5,280	91,842	1941	18,369	164,582
1909	459	7,385	1926	23,552	250,192	1942	7,453	67,503
1910	340	3,820	1927	13,018	154,764	1943	11,480	118,257
1911	466	5,294	1928	53,232	501,743	1944	25,581	180,065
1912	876	6,500	1929	15,541	170,563	1945-46	26,860	267,524
1913	460	3,700	1930	12,522	177,964			
1914	760	5,928	1931	13,960	222,583	Totals	329,675	$3,703,611
1915	692	4,002						

There is no established market covering bentonite and fullers earth. The wide range in physical and chemical properties of these materials, and the variation in individual specifications, make it essential that sales be based upon individual agreements. The range in price for crude bentonite in California is from $6.00 to $18.00 per ton, f.o.b. buyer's plant; depending on grade, quantity, and freight considerations. Most production is captive, however, and little crude bentonite is sold on the open market.

BITUMINOUS ROCK

Bibliography: State Mineralogist Rept. 12, 13, 15, 17, 18, 21, 22, 25, 26, 31, 39, 40.

Present production of bituminous rock is from Santa Cruz County. This material is a sandstone containing natural asphaltic material which fills the spaces between the sand grains, forming a cement. A few thousand tons have been marketed each year for many years as road dressing. Much larger tonnages of asphalt are produced as a by-product at oil refineries for use on roads.

Table 44. Annual tonnage and value of bituminous rock produced in California, 1887-1946

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2- or 3-year period (1931-32, etc.).

Year	Tons	Value	Years	Tons	Value	Year	Tons	Value
1887	36,000	$160,000	1905	24,753	$60,436	1923	2,945	$11,780
1888	50,000	257,000	1906	16,077	45,204	1924	6,040	14,922
1889	40,000	170,000	1907	24,122	72,835	1925	2,681	10,724
1890	40,000	170,000	1908	30,718	109,818	1926	3,863	21,577
1891	39,962	154,164	1909	34,123	116,436	1927	3,515	17,704
1892	24,000	72,000	1910	87,547	165,711	1928	4,966	38,832
1893	32,000	192,036	1911	75,125	117,279	1929	3,320	14,360
1894	31,214	115,193	1912	44,073	87,467	1930	8,525	36,075
1895	38,921	121,586	1913	37,541	78,479	1931-32	23,653	109,140
1896	49,456	122,500	1914	66,119	166,618	1933-34	36,793	130,301
1897	45,470	128,173	1915	17,789	61,468	1935-36	41,681	133,344
1898	46,836	137,575	1916	19,449	66,561	1937-38	36,128	139,242
1899	40,321	116,097	1917	5,590	18,580	1939	16,546	63,612
1900	25,306	71,495	1918	2,561	9,067	1940-41	29,709	86,903
1901	24,052	66,354	1919	4,614	18,537	1942-43	39,798	156,193
1902	33,490	43,411	1920	5,450	27,825	1944-46	13,448	60,158
1903	21,944	53,106	1921	8,298	43,192			
1904	45,280	175,680	1922	4,624	13,570	Totals	1,446,436	$4,650,320

Research on such asphaltic materials is quite likely to develop additional uses in the future, as for example, the production of light aggregates. Also research may result in the extraction of petroleum products from mined bituminous sands. Large quantities occur in various localities in the state, such as near Santa Maria and south of San Luis Obispo.

During 1946 the shipments of bituminous rock in California came from a single property in Santa Cruz County. The 1946 shipments showed a decrease in amount as compared with those of 1945.

CALCIUM SILICATE

Large deposits of wollastonite, or calcium silicate, occur in California. One occurs in the Rademacher district near Randsburg, Kern County; it is owned by the Johns-Manville Corporation, but only occasional shipments are made from this deposit to the company's plant in Los Angeles. The wollastonite is used in the manufacture of rock wool for insulation.

CARBON DIOXIDE

Bibliography: State Mineralogist Rept. 22, 38-40 (inc.).

Carbon dioxide produced during 1946 came from wells operated by one company near Niland, Imperial County, and by one company near Hopland, Mendocino County. The Cardox Western, Inc., of Los Angeles acquired National Dry Ice Company's plant and wells in 1944. The Natural Carbonic Products, Inc., suspended operations June 30, 1944. Because of the limited area of the carbon-dioxide field in the region about Niland, and suspension of operations of one of the companies, little possibility exists for an increase in production during 1947. However, there is a notably increasing demand for carbon dioxide for use in the refrigeration of foodstuffs and in the transportation of cut flowers.

Table 45. Annual volume and value of carbon-dioxide gas produced in California, 1894-1946

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2- or 3-year period (1933-35, etc.) or omitted (1946).

Year	M cu. ft.	Value	Year	M cu. ft.	Value	Year	M cu. ft.	Value
1894	80	$4,072	1936-37	89,777	$64,787	1943	227,424	$248,126
1895	800	12,000	1938-39	131,189	13,799	1944-45	429,382	524,280
1896	81	1,300	1940	97,660	23,877	1946		
1897	0	0	1941	138,862	258,563			
1933-35	15,440	1,822	1942	193,143	310,000	Totals	1,323,838	$1,462,626

During 1946 less carbon dioxide was produced but the value reported was greater than that of 1945. Most of the natural carbon dioxide produced in California is made into dry ice. A small percentage is sold as liquid carbon dioxide (CO_2).

CEMENT

Bibliography: State Mineralogist Rept. 8, 9, 12, 14, 15, 17, 18, 21-28 (inc.), 32, 39, 41; Bull. 38.

In 1947, California is leading all states in both the production and consumption of portland cement, and the mills are operating at a fairly high percentage of their rated capacity. The total (all-time) value of cement produced in this state is exceeded only by the total value of petroleum and gold.

Table 46. Annual amount and value of cement produced in California, 1891-1946

Year	Barrels	Value	Year	Barrels	Value	Year	Barrels	Value
1891	5,000	$15,000	1911	6,371,369	$9,085,625	1930	9,831,938	$14,575,731
1892	5,000	15,000	1912	6,198,634	6,074,661	1931	7,693,712	11,510,655
1893	0	0	1913	6,167,806	7,743,024	1932	5,657,549	7,967,107
1894	8,000	21,600	1914	5,109,218	6,558,148	1933	7,284,031	10,331,395
1895	16,383	32,556	1915	4,918,275	6,044,950	1934	8,936,085	12,445,616
1896	9,500	28,250	1916	5,299,507	6,210,293	1935	8,086,292	10,210,721
1897	18,000	66,000	1917	5,790,734	7,544,282	1936	13,300,188	18,314,589
1898	50,000	150,000	1918	4,772,921	7,969,909	1937	12,072,062	16,546,229
1899	60,000	180,000	1919	4,645,289	8,591,990	1938	10,561,037	15,502,574
1900	52,000	121,000	1920	6,709,160	14,962,945	1939	10,984,033	15,616,219
1901	71,800	159,842	1921	7,404,221	18,072,120	1940	13,955,255	17,673,202
1902	171,000	423,600	1922	8,962,135	16,524,056	1941	19,531,608	26,248,694
1903	640,868	968,727	1923	10,825,405	25,999,203	1942	23,306,578	35,808,841
1904	969,538	1,539,807	1924	11,655,131	23,225,850	1943	18,515,085	27,865,466
1905	1,265,553	1,791,916	1925	13,206,630	25,043,335	1944	14,599,752	21,249,520
1906	1,286,000	1,941,250	1926	13,797,173	25,269,678	1945	15,922,772	23,469,027
1907	1,613,563	2,585,577	1927	14,661,783	26,474,935	1946	19,546,336	32,403,081
1908	1,629,615	2,359,692	1928	13,625,231	24,463,287			
1909	3,779,205	4,969,437	1929	12,794,729	21,038,565	Totals	399,803,882	$629,490,482
1910	5,453,193	7,485,715						

Production is rising because of the high level of construction activity: large buildings, houses, highways, bridges, and aqueducts. The manufacture of concrete blocks for the building industry as a substitute for lumber is expanding rapidly, and large quantities of portland cement are used. Many blocks are made with pumice aggregate to achieve light weight.

Portland cement is made by heating to incipient fusion an intimate and finely pulverized mixture of argillaceous and calcareous materials. The resulting clinker is finely pulverized and approximately 3 percent of its weight in gypsum is added. The calcareous raw material is usually limestone, but oyster shells and marl are also used. The argillaceous material is clay or shale containing silica, alumina, and iron. Mills are usually located near centers of population so that heavy transportation charges can be avoided. California mills (1947) are equally divided between the southern and northern parts of the state, six mills in each part. Production in the state is considerably higher than consumption, and cement is available for export. Raw material for portland cement is abundantly available in many places in California for the expansion of the industry if that becomes desirable.

The cement production in California during 1946 totaled 19,546,336 barrels valued at $32,403,081 f.o.b. mill, of which 8,782,523 barrels worth $13,487,139 came from five northern California mills, and 10,763,-813 barrels worth $18,915,942 came from the six southern California mills. The 1946 cement output was an increase in both amount and value over that of 1945, when 15,922,772 barrels worth $23,469,027 were reported.

Shipments of cement during 1946 were made from eleven mills in nine counties: 20,159,380 barrels worth $33,878,096 f.o.b. plant, as compared with 15,864,134 barrels worth $23,469,662 in 1945. During the year five mills operated in northern California; one each in Calaveras, Contra Costa, San Mateo, Santa Clara, and Santa Cruz Counties, which shipped a total of 9,189,250 barrels worth $14,129,911; and six mills in southern California; three in San Bernardino County, and one each in Kern, Los Angeles[1] and Riverside Counties, which shipped a total of 10,970,130 barrels worth $19,748,185.

[1] The plant in Los Angeles County grinds clinker coming from other counties, therefore the crude material is credited to the point of origin.

Annual capacity of California cement mills, according to U. S. Bureau of Mines[2] was 25,770,000 barrels as of January 1, 1947, compared with 27,740,000 barrels for January 1, 1946. During the year an average of 2,740 men were employed in the above mills.

The mill of the Pacific Portland Cement Company at San Juan Bautista was down during 1946, but in February 1947 it reopened; shipments started the first of April.

Portland cement was first commercially produced in California in 1891; though in 1860 and for several years following, a natural hydraulic cement from Benicia was utilized in building operations in San Francisco.

> "The Benicia Cement Company in 1859-60 was turning out 50 to 100 barrels of cement a day and San Francisco was using about 12,000 barrels a year. The mill price of the product was then $4 a barrel. By 1865, the San Francisco rate of consumption had increased to 100,000 barrels yearly, brick buildings largely taking the place of frame structures, and the price of cement had fallen to $2.50 a barrel, about the same as it is today."[3]

The growth of the industry became rapid after 1902; since which time cement has continued to be an important factor in the industrial life of the state. Although the total cement figures, to date, are not of the same magnitude as those for gold and petroleum, it is interesting to note that the value of California's cement yield in the period 1920-31 and 1942-46 annually exceeded the value of her gold output.

CLAY[4]

Clay is the raw material used in making a great variety of articles including common brick, sewer tile, decorative tile, dinnerware, and table china. All of these and many similar products are manufactured in California. Because of California's large increase in population, the change in this industry has been very marked since the end of the war. During the war the manufacture of common brick and tile and many ceramic products was considered non-essential and hence the industry was operating at a low level.

Clay suitable for common brick is found at widely scattered points throughout California and is available at reasonable distances from centers where the population is sufficient to consume the output of a brick plant. Such plants, large and small, are scattered all over California. The wide availability of this type of clay keeps the prices down and precludes transportation for long distances.

Clays of higher grade, suitable for such products as fire brick and dinnerware, are found at three main centers, Ione in Amador County, Lincoln in Placer County, and Alberhill in Riverside County. All of these are remnants of deposits of clay hundreds of feet thick that were laid down in inland seas many millions of years ago when the climate of the region was semi-tropical. Prolonged decay of rock formations on the land furnished the material.

The various strata have a wide range in properties, and are kept separate in mining. In places, strata of very good silica sand are interbedded and are mined commercially. The usual method of mining is by stripping and then benching in open pits to expose the various strata; however, some strata of very high grade, such as fire clays and china clays, are mined by underground methods.

[2] Monthly Cement Report CP307, U. S. Bureau of Mines, Dec. 1946.
[3] Monthly Review of Mercantile Trust Co. of Calif., vol. 13, no. 3, p. 55, March, 1924.
[4] See also Dietrich, W. F., The clay resources and the ceramic industry of California: California Div. Mines Bull. 99, pp. 1-383, 1928.

The great demand for housing and other buildings includes demand for brick for walls and chimneys, for sewer tile, floor tile, and wall tile, for sanitary ware, and for tableware. Hence the clay industry continues to expand in 1947.

At one time or another in the history of the state, pottery clay has been mined in 37 of its counties. Of these, 17 contributed in 1946. In this report, pottery clay refers to all clays used in the manufacture of red and brown earthenware, china and sanitary ware, flower pots, floor, faience and ornamental tiling, architectural terra cotta, sewer pipe, drain and roof tile, and the figures for amount and value relate to the crude material at the pit without reference to whether the clay was sold in the crude form or was immediately used in the manufacture of any of the above finished products by the producer. They do not include clay used in making brick and hollow building blocks.

There are many other important uses for clay besides pottery manufacture, as in the paper, cotton goods, and chemical industries. Clays of the montmorillonite and halloysite group (rock soap) are being utilized successfully in the manufacture of soaps, for filtering oils, and as oil-well drilling mud; also as earth filler in irrigating ditches which run through porous ground.

Because a given product may require a mixture of several different clays not all found in the same pit, it is necessary for most clay-working plants to buy some part of their raw materials from other localities. For these reasons, in compiling the clay industry figures much care is required to avoid duplication. So far as it has been possible to segregate the figures from the data sent in by operators, clay output has been credited to the counties in which the raw material originated; tonnages used in brick manufacture have been deducted, as bricks are classified separately herein.

Pottery Clay

Pottery clay reported produced in California during 1946 from 36 properties in 17 counties totaled 604,140 net tons worth $1,606,256, f.o.b. pit for crude clay, compared with 40 properties in 18 counties which shipped 497,586 tons worth $1,345,966 in 1945.

The figures in table 47 do not include the clay reported used in the manufacture of brick and hollow building tile, or the bentonite clays.

The ceramic products reported manufactured in California during 1946 had a total value of $17,808,095 as compared with $10,650,381 in 1945.

Of the ceramic products, all groups listed in table 48 showed an increase in total value during 1946 over production of the previous year with the exception of chinaware and semi-vitreous tableware.

Brick and Hollow Tile

The varieties of brick produced in California are many; they include common, fire, pressed, glazed, enamel, fancy, vitrified, sand-lime, and others. Not only do the plants here supply practically all California requirements, but considerable quantities are shipped to contiguous territory, and certain products are shipped over a much wider radius.

Brick and hollow building tile were manufactured in California during 1946 in 34 plants which reported production in 16 counties, totaling 114,962 M common brick worth $2,175,855; 33,814 M fire brick

Table 47. Production of pottery clay during 1946, by county

NOTE: Where necessary in order to conceal output of individual producer in a county, production figures have been combined under "Unapportioned".

County	Tons	Value
Alameda	9,566	$16,166
Amador (includes fire sand)	90,416	194,061
Kern (includes oil-well drilling mud)	177,960	544,841
Los Angeles	78,182	179,247
Riverside	113,785	280,103
San Bernardino	16,577	104,855
Unapportioned (Calaveras, Humboldt, Marin, Orange, Placer, Sacramento, San Joaquin, Santa Clara, Stanislaus, Ventura Counties) (includes fire sand and oil-well drilling mud)	117,654	286,983
Totals	604,140	$1,606,256

Table 48. Ceramic products manufactured in California during 1946

Product	No. producers	Tons	Value	Product	No. producers	Tons	Value
Architectural terra cotta	4	-------	$772,665	Chinaware and semi-vitreous tableware	5	-------	3,791,580
Chimney pipe and flue lining	8	9,431	365,418	Conduit	3	16,132	519,383
Drain pipe	12	9,116	193,381	Fireclay and high-temperature cement	4	12,480	150,371
Sewer pipe (glazed)	9	116,030	4,123,180	Miscellaneous	12	-------	3,215,431
Floor, faience, mantel, and hand made tile	13	-------	3,161,699	Total value	89	-------	$17,808,095
Roofing tile	9	23,988	505,903				
Red earthenware	4	-------	282,086				
Stoneware and chemical stoneware	6	-------	726,998				

Table 49. Annual tonnage and value of pottery clay produced in California, 1887-1946

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1887	75,000	$37,500	1908	208,042	$325,147	1929	839,949	$1,127,527
1888	75,000	37,500	1909	299,424	465,647	1930	938,586	795,517
1889	75,000	37,500	1910	249,028	324,099	1931	332,680	408,931
1890	100,000	50,000	1911	224,576	252,759	1932	167,284	204,890
1891	100,000	50,000	1912	199,605	215,683	1933	141,629	211,711
1892	100,000	50,000	1913	231,179	261,273	1934	190,510	245,900
1893	24,856	67,284	1914	179,948	167,552	1935	240,014	377,969
1894	28,475	35,073	1915	157,866	133,724	1936	382,823	646,920
1895	37,660	39,685	1916	134,636	146,538	1937	354,669	705,200
1896	41,907	62,900	1917	166,298	154,602	1938	304,564	582,608
1897	24,592	30,290	1918	112,423	166,783	1939	305,517	611,599
1898	28,947	33,747	1919	135,708	245,019	1940	324,399	687,871
1899	40,600	42,700	1920	203,997	440,689	1941	551,347	1,217,363
1900	59,636	60,956	1921	225,120	362,172	1942	622,958	1,200,293
1901	55,679	39,144	1922	277,232	473,184	1943	622,019	1,185,240
1902	67,933	74,163	1923	376,863	697,841	1944	491,363	1,241,652
1903	90,972	99,907	1924	417,928	651,857	1945	497,586	1,345,966
1904	84,149	81,952	1925	537,587	674,376	1946	604,140	1,606,256
1905	133,805	130,146	1926	801,461	806,509			
1906	167,267	162,283	1927	867,419	872,661	Totals	16,377,947	$25,113,670
1907	160,385	254,454	1928	887,807	1,394,950			

(9-inch equivalent) worth $2,713,774; 9,589 M glazed, pressed, vitrified, and fancy brick worth $346,334; and 14,816 tons of hollow building tile worth $329,112. The entire output had a total value of $5,565,075 for the year. The 1946 production showed an increase in value in all types of brick and hollow tile as compared with the 1945 output, which was 52,955 M common brick worth $797,393; 29,514 M fire brick (9-inch equivalent) worth $2,276,683; 5,801 M glazed, pressed, and fancy brick worth $190,679; and 16,439 tons of hollow building tile worth $258,906, total value for the year being $3,523,661.

Table 50. Annual amount and value of brick (1893-1946) and hollow building tile (1917-46) produced in California

Year	Brick, M	Hollow building blocks, tons	Value	Year	Brick, M	Hollow building blocks, tons	Value
1893	103,900		$801,750	1921	238,022	67,100	$5,570,875
1894	81,675		457,125	1922	374,853	105,909	7,994,991
1895	131,772		672,360	1923	397,754	122,534	9,738,082
1896	24,000		524,740	1924	456,716	114,469	9,137,908
1897	97,468		563,240	1925	361,094	105,491	7,503,976
1898	100,102		571,362	1926	388,048	90,332	7,026,124
1899	125,950		754,730	1927	374,111	75,116	6,516,077
1900	137,191		905,210	1928	272,443	66,277	5,694,770
1901	130,766		860,488	1929	327,011	66,713	5,607,410
1902	169,851		1,306,215	1930	267,019	68,047	4,205,460
1903	214,403		1,999,546	1931	151,545	51,988	2,560,415
1904	281,750		1,994,740	1932	90,633	27,098	1,605,086
1905	286,618		2,273,786	1933	76,905	25,814	1,520,481
1906	277,762		2,538,848	1934	66,738	17,534	1,644,661
1907	362,167		3,438,951	1935	76,521	21,309	1,855,343
1908	332,872		2,506,495	1936	131,667	16,081	2,240,905
1909	333,846		3,059,929	1937	148,833	17,521	3,083,902
1910	340,883		2,934,731	1938	129,273	16,592	2,594,546
1911	327,474		2,638,121	1939	150,503	16,283	3,063,660
1912	337,233		2,940,290	1940	129,887	29,048	2,762,885
1913	358,754		2,915,350	1941	137,925	16,513	3,593,797
1914	270,791		2,288,227	1942	180,935	24,703	5,708,967
1915	180,538		1,678,756	1943	113,935	16,947	4,368,675
1916	206,960		2,096,570	1944	110,576	18,702	3,930,662
1917	192,269	29,348	2,532,721	1945	88,270	16,439	3,523,661
1918	136,374	34,818	2,363,481	1946	158,365	14,816	5,565,075
1919	156,328	35,026	3,087,067				
1920	245,842	99,208	5,704,393	Totals	11,343,171	1,428,776	$175,032,616

The 1946 output came from thirteen plants in Los Angeles County, three in Contra Costa County; two each in Alameda, Amador, Kern, and Sacramento Counties; and one each in Fresno, Humboldt, Placer, Riverside, San Bernardino, San Diego, San Joaquin, San Luis Obispo, Santa Barbara, and Santa Clara Counties.

DIATOMITE[5]

California is the most important source of diatomaceous earth, a light, porous, chalk-like material compound composed of silicious remains of microscopic plants. By far the largest production in the United States comes from a deposit at Lompoc, Santa Barbara County. The deposit second in importance in California is in the San Pedro Hills, Los Angeles County. Other deposits are located in Contra Costa, Fresno, Inyo, Kern, Monterey, Orange, Plumas, San Benito, San Bernardino, San Joaquin, San Luis Obispo, Shasta, Sonoma, and Tehama Counties.

Distribution of uses for diatomite is about as follows: Filtration, 50 percent; insulation, 25 percent; fillers, 20 percent; miscellaneous, 5 percent.

During the recent war, diatomite producers were handicapped because exportation was cut off. In 1946, there was an increase in the production of diatomite, although operating companies were hampered by the shortage of labor. Increase in production during 1947 is probable as companies resume shipments of both filtration and insulation material to foreign markets.

The producers have installed power shovels and modern labor-saving devices to cut labor costs and combat scarcity of labor. Principal pro-

[5] See also Mulryan, Henry, Geology, mining, and processing of diatomite at Lompoc, Santa Barbara County, California: California Div. Mines Rept. 32, pp. 133-166, 1936.

ducers are Johns-Manville Corporation, owner and operator of Lompoc deposits, Santa Barbara County; Great Lakes Carbon Company, which purchased the Dicalite Company's deposit in Los Angeles County; and Lompoc Diatomite Company, Lompoc, Santa Barbara County.

As about 75 percent of the California output is from a single operator, the exact figures have been concealed under *Unapportioned* in the state and county totals. There were four producing properties during 1946: two were in Santa Barbara County, and one each in Los Angeles and Modoc Counties. Shipments during the year showed an increase in amount and value as compared with 1945.

The material shipped was utilized for heat and sound insulation, filtration, paint, pigment, cement admixture, filters, abrasives, and for clarification of gasoline and kerosene.

Table 51. Annual tonnage and value of diatomite produced in California, 1889-1946

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2- or 3-year period (1921-22, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1889	39	$1,335	1904	6,950	$112,282	1918	35,963	$189,459
1890	0	0	1905	3,000	15,000	1919	40,200	217,800
1891	0	0	1906	2,430	14,400	1920	60,764	1,056,260
1892	0	0	1907	2,531	28,948	1921-22	90,739	1,016,675
1893	50	2,000	1908	2,950	32,012	1923-25	193,064	5,729,736
1894	51	2,040	1909	500	3,500	1926-28	275,403	1,995,923
1895	0	0	1910	1,843	17,617	1929-31	300,017	4,848,661
1896	0	0	1911	2,194	19,670	1932-34	203,228	3,104,154
1897	5	200	1912	4,129	17,074	1935-37	290,908	4,243,572
1898	0	0	1913	8,645	35,968	1938-40	266,358	3,941,941
1899	0	0	1914	12,840	80,350	1941-43	425,745	6,692,051
1900	0	0	1915	12,400	62,000	1944-46	460,654	9,324,111
1901	0	0	1916	15,332	80,649			
1902	422	2,532	1917	24,301	127,510	Totals	2,746,358	$43,031,445
1903	2,703	16,015						

DOLOMITE

Bibliography: State Mineralogist Rept. 15, 17, 27, 28, 31, 33-34 (inc.), 37, 39.

The dolomite produced and shipped in California during 1946 came from single properties in each of the following counties: Inyo, Monterey, San Benito, and Tuolumne. The annual details are concealed under *Unapportioned* (table 40), to conceal the output of the individual companies. The 1946 output showed a larger tonnage, but a decrease in total value, as compared with the tonnage and value recorded for the previous year. This in part is accounted for, as most of the material produced is from captive quarries, and cost plays a large part in value.

Table 52. Annual tonnage and value of dolomite produced in California, 1915-46

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1930-31, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1915	4,192	$14,504	1926	68,640	$119,313	1938	4,363	$18,339
1916	13,313	46,566	1927	45,976	79,422	1939	17,791	40,391
1917	27,911	66,416	1928	38,379	85,342	1940	18,178	52,167
1918	24,560	79,441	1929	58,644	156,928	1941	22,300	64,595
1919	24,502	67,953	1930-31	66,564	161,245	1942	142,552	413,469
1920	42,388	132,791	1932	35,275	40,95	1943	331,251	472,756
1921	31,195	99,155	1933	54,456	176,575	1944	217,018	619,425
1922	52,409	114,911	1934-35	108,645	304,984	1945-46	464,633	1,137,289
1923	69,519	142,615	1936	25,807	63,102			
1924	28,843	71,271	1937	12,371	24,632	Totals	2,094,527	$4,971,453
1925	42,852	104,900						

Most of the dolomite produced during the year was burnt to lime, and used in the production of magnesia from sea water. Some of the raw dolomite was used for steel-furnace flux and refractories, stucco dash, terrazzo and roofing granules, kalsomine, poultry grit, artstone, and in the manufacture of mineral wool and carbon dioxide.

Previous to the 1915 statistical report of the State Mining Bureau, dolomite was included with limestone, as the two minerals are closely related chemically; but since dolomite, as such, has been found to have certain distinctive applications, it is now given a separate classification.

FELDSPAR

Bibliography: State Mineralogist Rept. 15, 17-28 (inc.), 30, 31, 34-41 (inc.) ; Bull. 67, 91. U. S. Bur. Mines, Bull. 92.

At present, most of the feldspar used in California is shipped from Arizona and Nevada, where large and exceptionally pure deposits are worked, and favorable freight schedules allow competition with California deposits. Formerly productive deposits of feldspar in California are in the counties of Fresno, San Bernardino, San Diego, Inyo, and Plumas. Undeveloped or partly developed deposits are known in many other counties. The shift of industry to the Pacific Coast, coupled with accelerated population growth and demand for manufactured products, may bring about the reopening of the idle California feldspar deposits and development of new deposits. The demand may make practicable the application of ore-dressing methods to the concentration and processing of feldspar and the profitable operation of many medium-grade deposits now idle.

Total production of all classes of feldspar in the United States is at the rate of approximately 325,000 tons per year, average value about $2,000,000. More than 95 percent of the production is used in various branches of the ceramic industry, more than 50 percent being used in the glass industry alone. The manufacture of enamels, high grades of pottery, chinaware, and porcelains demands about 40 percent of the production.

The feldspar produced and shipped in California during 1946 came from a single property in Madera County. The 1946 output showed a slight increase in both amount and value over the previous year. The annual details are concealed under *Unapportioned* (table 40), so as not to reveal the output of a single operator. Early in 1947 a feldspar deposit in Kern County was opened, and it is likely that the output for 1947 will be greater than the 1946 production. A large tonnage of glass feldspar contained in sands from Contra Costa, Monterey, and Riverside Counties, is reported under glass sand and computed under silica, because the largest percentage of these sands is quartz.

The requirements of the pottery trade demand that in general the percentage of free silica associated with the feldspar be less than 20 percent, and in some cases the potters specify less than 5 percent. An important factor, also, is the iron-bearing minerals frequently present in pegmatites and granites, such as biotite (black mica), garnet, hornblende and black tourmaline. Feldspar for pottery uses should be practically free of these. The white potash-mica, muscovite, is not particularly objectionable except that being in thin, flexible plates, it does not readily grind to a fineness required for the feldspar. Feldspar is also used in the manufacture of glass, enamel and sanitary ware, in soaps and

Table 53. Annual tonnage and value of feldspar produced in California, 1910-46

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1933-34).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1910	760	$5,720	1922	4,587	$37,109	1935	3,265	$21,855
1911	740	4,560	1923	11,100	81,800	1936	3,430	24,959
1912	1,382	6,180	1924	9,055	68,112	1937	2,686	10,930
1913	2,129	7,850	1925	8,165	59,615	1938	1,378	6,970
1914	3,530	16,565	1926	7,300	56,400	1939	2,076	12,510
1915	1,800	9,000	1927	10,932	86,101	1940	3,022	16,644
1916	2,630	14,350	1928	14,628	93,745	1941-42	10, 40	56,718
1917	11,792	46,411	1929	13,327	78,404	1943-44	4,090	11,152
1918	4,132	22,031	1930	5,014	35,654	1945-46	127	1,893
1919	1,272	12,965	1931	4,795	59,921			
1920	4,518	26,189	1932	2,294	15,988	Totals	162,900	$1,067,285
1921	4,349	28,343	1933-34	2,655	30,611			

abrasives, and as a binder for abrasive wheels, all of which have specifications similar to those for pottery.

Crude No. 1 grade feldspar is sold at present at from $7.00 to $10.00 per short ton, f.o.b. car California points. Specifications vary with the individual purchaser, but in general for glass and ceramic use, a No. 1 grade crude feldspar should conform to the following analysis:

Burn to a uniform white color free from specks or spots.
Contain not more than 0.1 percent Fe_2O_3.
Contain not more than 5 percent free silica.
Contain not less than 12 percent K_2O.
Contain not less than 17 percent Al_2O_3.

Some variation from the foregoing specifications can be tolerated according to the industry in which the material is used, but the color requirements and low iron content are insisted upon by most users.

FLUORSPAR

Bibliography: State Mineralogist Rept. 17, 18, 19, 26, 38, 39, 41; Eng. and Min. Jour.-Press, vol. 177, pp. 489-492, Mar. 22, 1924.

During 1946 no fluorspar was reported mined or shipped in California.

Fluorspar, or calcium fluoride, CaF_2, is one of the most important nonmetallic minerals from an industrial standpoint. About 80 percent of the commercial mineral is prepared in gravel form and utilized as a flux in the manufacture of steel, for which use no substitute has yet been found.

In California, deposits have been reported in Los Angeles, Mono, Riverside and San Bernardino Counties. A previous commercial production was made in 1917-18, when 79 tons valued at $991 was shipped from Riverside County. In 1933-34 227 tons worth $3,631 was shipped from San Bernardino County; and in 1944-45 130 tons worth $4,290 was shipped from Rice, Riverside County.

At present, a limited but active demand exists for metallurgical-grade fluorite in California; and a rapidly growing demand for acid-grade spar. Probably the demand would be at least double the present supply at the following prices:

Metallurgical-grade spar: base 85 percent CaF_2, maximum silica 6 percent, maximum sulphur 0.2 to 0.3 percent; $25 per short ton f.o.b. California points.

Acid grade spar: base 97.5 percent CaF_2 ground 95 percent minus 200-mesh, maximum silica 2.0 percent, maximum calcium carbonate 1.0 percent, maximum Al_2O_3, 1 percent, maximum Fe_2O_3, 0.1 percent, no manganese or chromium; $70 per short ton f.o.b. Los Angeles. Some buyers of acid grade spar do not insist on the foregoing rigid specifications, but price is correspondingly lower. Corresponding eastern prices are:

Metallurgical grade, base 70 percent CaF_2, crude, f.o.b. mines Kentucky or Illinois, bulk, $34.50 per short ton. Acid grade, base 98 percent CaF_2 and 1 percent silica, f.o.b. mines Kentucky or Illinois, per bulk short ton, $38.50, (October 1947).

GARNET

Very large potential reserves of garnet exist in California, principally in the pegmatites and in tactite areas associated with tungsten ores in the central and southern parts of the state. A small and intermittent production is made, amounting to less than a thousand tons per year in California, all of which is used as an abrasive sand in tumbling-barrels or sand blasting. The airplane manufacturing industry is the principal consumer. Most of the garnet produced in the state is recovered from mill tailing produced in the concentration of tungsten ore, and the production of garnet except as a by-product resulting from the beneficiation of other minerals has not been economic. The average selling price for sized garnet for sand blasting is from $16.00 to $18.00 per ton.

Research into new uses and markets for garnet may result in a greatly expanded demand as the industrialization of California proceeds. Garnet should make an ideal aggregate for concrete factory floors subject to shock and abrasion, and should find a much wider application in sand blasting, in the manufacture of abrasive papers, and other allied fields where its hardness and toughness are advantageous. The tactites or garnet rocks of California are not as brittle as the crystalline garnet of the Appalachian region.

Abrasive garnets were shipped in California in 1938, 1939, and 1945, amounting to a grand total of 1,423 tons worth $24,795, all of which came from tungsten mines in Mono and Inyo Counties.

GEMS

Bibliography: State Mineralogist Rept. 2, 14, 15, 17, 18, 20, 21-28 (inc.), 30-32 (inc.), 34-35, 40, 41; Bull. 37, 67, 91. Mineral Resources U. S., U. S. Geol. Survey Bull. 603, p. 208. Univ. California, Dept. Geol. Sci. Bull. vol. 5, pp. 149-153, 331-380. Am. Jour. Sci., vol. 31, p. 31.

The production of gem materials in California has been somewhat irregular since 1911. The compilation of complete statistics is difficult owing to widely scattered places at which stones are gathered and marketed, for the most part in a small way. The gem material reported mined and shipped during 1946 in California came from a single property each in San Bernardino and San Luis Obispo Counties. Annual details are concealed under *Unapportioned* (table 40) item so as not to reveal the output of either producer. The material reported for the year was agate. The 1944-45 output had a total value of $21,075. In 1944 the total production was optical and piezoelectric quartz from Calaveras and Tulare Counties.

Diamonds have been found in a number of localities in California; but in every case, they have been obtained in stream gravels being worked

Table 54. Annual value of gems produced in California, 1900-46

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1944-45) or omitted (1946).

Year	Value	Year	Value	Year	Value	Year	Value
1900	$20,500	1912	$23,050	1924	$4,800	1936	$2,878
1901	40,000	1913	13,740	1925	10,663	1937	2,075
1902	162,100	1914	3,970	1926	9,049	1938	4,575
1903	110,500	1915	3,565	1927	7,035	1939	2,500
1904	136,000	1916	4,752	1928	22,200	1940	3,176
1905	148,500	1917	3,049	1929	26,850	1941	870
1906	497,090	1918	650	1930	3,540	1942	570
1907	232,642	1919	5,425	1931	5,607	1943	329,868
1908	208,950	1920	36,056	1932	4,961	1944-45	21,075
1909	193,700	1921	10,954	1933	690	1946	
1910	237,475	1922	1,312	1934	2,456		
1911	51,824	1923	13,220	1935	945	Total value	$2,625,407

for gold. The principal districts have been: Volcano in Amador County; Placerville, Smith's Flat, and others in El Dorado County; French Corral, Nevada County; Cherokee Flat, Morris Ravine, and Yankee Hill, Butte County; Gopher Hill and upper Spanish Creek, Plumas County. The most productive district of recent years has been Cherokee in Butte County.

California *tourmalines* are decidedly distinctive in coloring and fire as compared to foreign stones of this classification. The colors range from deep ruby to pink, and include various shades of green, also blue.

One California gem stone, *benitoite,* has not been found elsewhere; and in but a single locality here: the Dallas mine in San Benito County.

Kunzite, a gem variety of spodumene, was first found in the Pala district in San Diego County. It has thus far been found in only one locality (Madagascar) outside of California. It is of a lilac color, and is described in detail in Bulletin 37 of the State Mining Bureau.

Beryls of excellent fire and delicate colors are also obtained in the Pala district, of which the *aquamarine* (blue) and *morganite* (pink) varieties deserve special mention. Morganite, like kunzite, has thus far been found elsewhere only in Madagascar.

Californite, or California jade, is a gem variety of *idocrase (vesuvianite),* and is green or white in color. It is found in Butte, Fresno, and Siskiyou Counties.

Stones of precious blue *topaz* of fine quality are being cut from crystals mined in northern San Diego County. They are associated with beryl and blue tourmaline.

Some *rhodonite* has been mined in Siskiyou County, and used for decorative puposes, its value being included in the marble figures.

Garnets are found in a number of localities in California; the important yield of gems being hyacinth and spessartite varieties from San Diego County.

Chrysoprase has been produced in Tulare County.

Turquoise has been found in the desert section of San Bernardino County, but none produced commercially in recent years.

It is reported, but not yet confirmed, that *sapphires* have been found in San Bernardino and Riverside Counties. A few have been found in stream gravels with diamonds in Butte County.

Rubies have been identified by the laboratory of the State Mining Bureau, occurring in limestone from the Baldy Mountains, San Bernardino County. Thus far no stones of commercial size have been taken out.

GRAPHITE

Bibliography: State Mineralogist Rept. 14, 15, 17-26 (inc.), 30, 33, 35; Bull. 67, 91.

Graphite (also called plumbago) has been produced from time to time in the state, coming principally from Sonoma and Los Angeles Counties.

Occurrences of graphite have been reported in Calaveras, Fresno, Imperial, Inyo, Los Angeles, Mendocino, San Bernardino, San Diego, Siskiyou, Sonoma, and Tuolumne Counties. From 1931-33 a small production of graphite came from a property in Los Angeles County.

During 1946 no production of graphite was reported in California. In 1935 a small output of graphite came from a single property in Los Angeles County. This material was used for experimental purposes. The annual details are concealed under *Unapportioned* (table 40) in order not to reveal the output of the single operator.

The useful characteristics of graphite are its infusibility and resistance to the action of molten metals. It is also used in the manufacture of electrical appliances, of lead pencils, as a lubricant, as stove polish, in paints and in many other ways. Amorphous graphite, commonly carrying many impurities, brings a much lower price. For some purposes, such as foundry facings, the low-grade material is satisfactory. Among the interesting uses for graphite is the prevention of formation of scale in boilers. The action is a mechanical one. Being soft and slippery, the graphite prevents the particles of scale from adhering to one another or to the boiler and they are thus easily removed.

Domestic graphite mines cannot compete with imported graphite and artificial graphite made from coke, except in war time when imports are cut off; or where mines are favorably situated and can be worked cheaply. California has produced a little graphite sold at from $10.00 to $15.00 per ton, crude sorted, f.o.b. mine. New York quotations (Oil, Paint and Drug Reporter, October 6, 1947) are: Amorphous powdered, bags, ex. warehouse, 4 cents to 6 cents per pound; crystalline, 88 to 90 percent, powdered, bags, ex. warehouse, 14 cents to 16 cents per pound; flake, No. 1, 90 to 95 percent, cartons or bags, ex. warehouse, 21 cents to 22 cents per pound; domestic crude amorphous, f.o.b. New York, sold at $12.00 to $35.00 per ton, according to grade.

GYPSUM

Bibliography: State Mineralogist Rept. 14, 15, 17, 18, 22, 23, 25-28 (inc.), 30, 31, 33-36 (inc.), 38-41 (inc.); Bull. 38, 67, 91. U. S. Geol. Survey Bull. 223, 413, 430, 697. U. S. Bur. Standards Circular 281.

Production of gypsum in California for the year 1947 will probably equal or exceed the all-time high of 618,007 tons in 1946. The tremendous growth of gypsum production, from 70,833 tons in 1935 to the 1946 high, received much of its impetus in the early years of this period from increase in agricultural uses. More recently, however, use of gypsum in building materials, such as hard-wall and other plasters, wall board, and cement has surpassed that for agricultural purposes.

A large part of the agricultural gypsum is produced in the San Joaquin Valley, where it is excavated by scrapers, after removal of a small overburden, loaded directly into trucks, and delivered to the farm lands on which it is to be used. Shipments of this material are also being

Table 55. Annual poundage and value of graphite produced in California, 1901-36

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2- to 4-year period (1917-20, etc.).

Year	Pounds	Value	Year	Pounds	Value	Year	Pounds	Value
1901	128,000	$4,480	1916	29,190	$2,335	1931-33	156,000	$11,950
1902	84,000	1,680	1917-20	770,000	37,225	1934	0	0
1903	0	0	1921-22	624,000	26,160	1935	104,000	520
1913	2,500	25	1923	0	0	1936		0
1914	0	0	1925-27	76,000	13,120			
1915	0	0	1928	0	0	Totals	1,973,690	$87,495

Table 56. Annual tonnage and value of gypsum produced in California, 1887-1946

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1887	2,700	$27,000	1908	34,600	$155,400	1929	140,844	$396,951
1888	2,500	25,000	1909	30,700	138,176	1930	116,865	243,507
1889	3,000	30,000	1910	45,294	129,152	1931	88,354	199,198
1890	3,000	30,000	1911	31,457	101,475	1932	46,867	93,818
1891	2,000	20,000	1912	37,529	117,388	1933	59,235	120,451
1892	2,000	20,000	1913	47,100	135,050	1934	58,149	113,606
1893	1,620	14,280	1914	29,734	78,375	1935	70,833	151,807
1894	2,446	24,584	1915	20,200	48,953	1936	143,549	282,703
1895	5,158	51,014	1916	33,384	59,533	1937	186,160	384,431
1896	1,310	12,580	1917	30,825	56,840	1938	161,996	327,821
1897	2,200	19,250	1918	19,695	37,176	1939	219,672	437,343
1898	3,100	23,600	1919	19,813	50,579	1940	314,843	599,944
1899	3,663	14,950	1920	20,507	92,535	1941	432,784	854,184
1900	2,522	10,088	1921	37,412	78,875	1942	425,268	791,892
1901	3,875	38,750	1922	47,084	188,336	1943	475,967	916,883
1902	10,200	53,500	1923	86,410	289,136	1944	558,488	949,833
1903	6,914	46,441	1924	25,569	53,210	1945	442,133	954,696
1904	8,350	56,592	1925	107,613	172,444	1946	618,007	1,431,884
1905	12,859	54,500	1926	114,868	211,337			
1906	21,000	69,000	1927	94,630	292,090	Totals	5,689,575	$12,636,408
1907	8,900	57,700	1928	104,790	200,567			

Table 57. Production of industrial limestone during 1946, by county

(Includes shells dredged from San Francisco Bay in San Mateo and Santa Clara Counties.) NOTE: Where necessary in order to conceal output of individual producer in a county, production figures have been combined under "Unapportioned".

County	Tons	Value
El Dorado	248,402	$578,136
San Bernardino	300,833	556,864
Santa Cruz	31,918	168,250
Unapportioned (Fresno, Inyo, San Diego, San Mateo, Santa Clara, Tuolumne, Ventura Counties)	186,017	671,229
Totals	767,170	$1,974,479

made from eastern Riverside County. This is a stable industry, which may be expected to continue at its present rate of production or with a gradual increase, as more farmers learn of the advantages of using gypsum.

Most of the gypsum for industrial use comes from Imperial and Riverside Counties and is marketed in the form of manufactured products. That used in the manufacture of cement in southern California comes from Ventura County. Present rate of production of these materials will no doubt be maintained or increased during the building-boom period.

The largest producer of gypsum products in the state is the United States Gypsum Company, which in the last few years has increased the capacity of its plant at Midland, in eastern Riverside County, from 300 tons to 800 tons per day, although, owing to labor shortage, much of its production has been at the rate of 600 tons per day. This is all turned out as processed materials consisting of wall plaster, finishing and casting plaster, and manufactured products such as wall board and lath. This company also has purchased recently a deposit and a plant at Plaster City, Imperial County, from the Pacific Portland Cement Company, and is now engaged in doubling the capacity of this plant.

The gypsum reported produced in California during 1946 totaled 618,007 net tons, value $1,431,884, compared with 442,133 tons, value $954,696, in 1945, and came from three properties in Kern County and one each in Fresno, Imperial, Monterey, Riverside, and Ventura County. An additional production from Alameda County of calcium sulphate was made during the chemical process of precipitating magnesium hydroxide from salt-works bittern with lime.

LIMESTONE AND LIME[6]

In 1946, production of limestone in California broke all records; it is continuing at a high level in 1947. Deposits that are equipped for production are being operated at practically full capacity, and additional deposits are being equipped.

Limestone or dolomite occur in all but a few of the counties in California, but only about 10 counties are important producers. The complexity of the geologic structure of the state, together with the discontinuity and local variation of the magnesia-lime ratio, cause many problems in both exploration and operation. In the Sierra Nevada, the limestones from Calaveras County to the south are likely to contain considerable magnesia. From Amador County to the north, the limestone is largely of the high-calcium variety. Recent sampling in Tuolumne County gave the following results from adjacent beds: for a width of 600 feet the limestone is high in calcium; for a width of 300 feet, 35.46 percent magnesium carbonate, 60.77 percent calcium carbonate. In four counties of the state, oyster shells are utilized as a substitute for limestone in poultry feeds and fertilizer, and for burning to lime. At the south end of San Francisco Bay, oyster shells dredged from the bay are used in the manufacture of portland cement. San Bernardino County and the Coast Range counties south of San Francisco are large producers of both limestone and dolomite. Shasta County is very abundantly supplied with limestone of three different geologic ages, but little is being done with it

[6] See also Logan, C. A., Limestone in California, California Jour. Mines and Geology, vol. 43, pp. 175-357, 1947.

Table 58. Annual tonnage and value of industrial limestone produced in California, 1894-1946

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1894	15,420	$19,275	1913	301,918	$274,455	1931	177,268	$560,699
1895	71,355	71,690	1914	572,272	517,713	1932	168,950	487,788
1896	68,184	71,112	1915	146,324	156,288	1933	207,371	487,712
1897	36,796	38,556	1916	187,521	217,733	1934	198,057	461,139
1898	27,686	24,548	1917	237,279	356,396	1935	227,214	496,054
1899	30,769	29,185	1918	208,566	456,258	1936	295,792	661,757
1900	32,791	31,532	1919	88,291	248,145	1937	351,755	830,562
1901	76,937	99,445	1920	90,120	298,197	1938	302,665	729,149
1902	71,422	90,524	1921	75,921	305,912	1939	316,029	838,235
1903	125,919	163,988	1922	84,382	282,181	1940	563,999	895,832
1904	40,207	87,207	1923	143,266	348,464	1941	459,153	801,868
1905	192,749	323,325	1924	219,476	582,660	1942	474,764	1,155,352
1906	80,262	162,827	1925	319,977	494,525	1943	495,262	1,378,647
1907	230,985	406,041	1926	108,795	367,501	1944	734,425	1,714,414
1908	273,890	297,264	1927	699,790	663,957	1945	532,480	1,626,844
1909	337,676	419,921	1928	127,895	397,935	1946	767,170	1,974,479
1910	684,635	581,208	1929	168,315	557,617			
1911	516,398	452,790	1930	169,477	508,751	Totals	13,749,395	$26,075,905
1912	613,375	570,248						

in 1947, although formerly large tonnages were used as flux at copper smelters.

Lime, which is made by heating limestone to drive off the carbon dioxide, is one of the more important industrial chemicals. Raw limestone also has many industrial uses; for instance, as flux in smelting ores for recovery of metals. Finely pulverized limestone is added to soils to reduce acidity, to supply calcium as plant food, and to improve certain soils in other ways. The largest tonnages of limestone go into the manufacture of portland cement, but this use is considered separately in this report, under the heading *Cement*. Small amounts of marble, a variety of limestone, are still used in the building industry, and this is mentioned under the heading *Stone for Monuments and Buildings*. In California, only small amounts of limestone are used as crushed rock in aggregate for concrete and in building roads. In a few industries such as the manufacture of soda-ash and the production of beet-sugar, both the lime and the carbon dioxide driven from the limestone to make lime are utilized in the process.

Lime is used in the open-hearth steel industry, in brick mortar, plaster, glass, stucco, fruit-sprays, water-purification, sugar-refining, manufacture of paper, and in many smaller industries. Dolomitic lime, which is made by heating dolomite, the double carbonate of calcium and magnesium, is mentioned under the heading of *Magnesium Compounds*. Much dolomite is used at open-hearth steel furnaces also.

Industrial limestone was shipped from 21 properties in 10 counties during 1946 and totaled 767,170 net tons worth $1,974,479 as compared with 532,480 tons worth $1,626,844 in 1945. The above figures do not include the limestone used in the manufacture of cement.

Included in the above figures are 206,007 tons of limestone used in making 103,628 tons of lime worth $1,040,592, which came from two properties each in El Dorado and San Bernardino Counties and one property each in Alameda, Santa Cruz, and Tuolumne Counties; also included are 71,771 tons of limestone worth $518,242, which were used for agricultural purposes and poultry grit, stock feed and as a filler in fertilizers. The lime figures do not include calcined dolomite used in the precipitation of magnesia from sea water.

Table 59. Annual tonnage and value of lime produced in California, 1894-1941

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1894	37,350	$318,700	1911	42,959	$390,988	1928	56,616	$547,919
1895	39,776	386,094	1912	52,212	464,440	1929	42,834	417,101
1896	30,275	261,505	1913	61,344	528,547	1930	47,662	452,084
1897	28,780	252,900	1914	43,996	378,663	1931	36,189	360,523
1898	29,786	254,010	1915	35,653	286,304	1932	27,510	254,223
1899	29,985	314,575	1916	49,364	390,475	1933	33,425	271,619
1900	31,252	283,699	1917	50,073	311,380	1934	32,500	309,765
1901	31,738	334,688	1918	43,684	461,315	1935	59,731	573,212
1902	44,866	369,616	1919	42,070	552,043	1936	64,275	633,678
1903	49,659	418,280	1920	46,314	557,232	1937	69,532	681,277
1904	57,945	571,749	1921	46,353	610,619	1938	70,578	683,403
1905	61,700	555,322	1922	57,875	671,747	1939	87,288	849,122
1906	68,927	763,060	1923	70,894	788,834	1940	101,395	902,322
1907	68,422	756,376	1924	62,029	703,355	1941	110,719	9 6,514
1908	39,639	379,243	1925	61,922	685,528			
1909	52,075	577,824	1926	63,568	670,837	Totals	2,481,188	$24,311,890
1910	47,951	477,683	1927	60,498	631,497			

Table 58 gives the amounts and values of industrial limestone produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau. These tonnages consist principally of limestone utilized for flux, glass and sugar making, agricultural, chemical, and other special industrial purposes. That utilized in cement manufacture is not included. Beginning in 1942 the limestone used in the manufacture of burnt lime was included with these figures, instead of being kept separate as a structural material, as most of the lime is being used in metallurgical and chemical industry, and not in construction as in previous years.

The early output of lime in California was entirely for structural purposes. Later a small percentage was put out for chemical, agricultural, and industrial uses, and still later lime replaced limestone in metallurgy. In 1942 the structural use had decreased, and other uses increased to such a point that it was decided to include lime with industrial limestone in the statistical reports.

Table 59 gives the amounts and value of lime produced in California by years since 1894, when compilation of such records was begun by the State Mining Bureau. The figures for quantity have been recalculated from barrels, as shown in the earlier reports, to tons for the years 1894-1922, inclusive.

LITHIUM COMPOUNDS

Bibliography: State Mineralogist Rept. 2, 4, 14, 21, 30, 35, 39; Bull. 38, 67, 91.

Lithium-bearing ores, lepidolite, amblygonite, and spodumene, are found in San Diego and Riverside Counties, but no production was made in 1946. Aside from production of lithium from Searles Lake, the output will be small in 1947.

Lithium salts occur in the brines of Searles Lake near Trona, San Bernardino County. The by-product lithium is recovered by flotation as lithium-sodium phosphate, containing about 22 percent Li_2O, by the American Potash & Chemical Corporation. Production is limited by the size of equipment available to recover potash, borates, and soda, the main products.

The 1946 output of lithium compounds has the largest recorded value for any year in California and placed the state first in the production of these materials in the nation. The figures for the year were placed in the *Unapportioned* item in table 40 to conceal the output of the producer.

Table 60. Annual tonnage and value of lithium compounds produced in California, 1899-1946

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2- or 3-year period (1921-22, etc.) or omitted (1946).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1899	124	$4,600	1916	71	$1,065	1926-28	550	$13,900
1900	440	11,000	1917	880	8,800	1929	0	0
1901	1,100	27,500	1918	4,111	73,998	1938-39	378	100,338
1902	822	31,880	1919	800	14,400	1940-41	366	84,099
1903	700	27,300	1920	10,046	153,502	1942-43	478	114,148
1904	641	25,000	1921-22	1,365	20,781	1944-45	1,554	357,802
1905	25	276	1923	0	0	1946		
1906	0	0	1924	109	2,269			
1915	91	1,365	1925	0	0	Totals	24,651	$1,074,023

Table 61. Annual tonnage and value of magnesite produced in California, 1887-1946

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1932-33, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1887	600	$9,000	1906	4,032	$40,320	1924	67,236	$900,183
1888	600	9,000	1907	6,405	57,720	1925	64,623	872,944
1889	600	9,000	1908	10,582	80,822	1926	50,915	587,642
1890	600	9,000	1909	7,942	62,588	1927	46,093	577,887
1891	1,500	15,000	1910	16,570	113,887	1928	45,645	501,590
1892	1,500	15,000	1911	8,858	67,430	1929	47,269	488,014
1893	1,093	10,930	1912	10,512	105,120	1930	38,681	388,472
1894	1,440	10,240	1913	9,632	77,056	1931	21,576	182,283
1895	2,200	17,000	1914	11,438	114,380	1932-33	40,303	282,325
1896	1,500	11,000	1915	30,271	283,461	1934-35	62,509	413,228
1897	1,143	13,671	1916	154,052	1,311,893	1936-37	94,491	734,443
1898	1,263	19,075	1917	209,648	1,976,227	1938-39	47,954	375,005
1899	1,280	18,480	1918	83,974	803,492	1940-41	241,620	2,069,220
1900	2,252	19,333	1919	44,696	452,098	1942-43	198,259	1,821,978
1901	4,726	43,057	1920	83,695	1,033,491	1944-45	16,784	167,910
1902	2,830	20,655	1921	47,837	511,102	1946	0	0
1903	1,361	20,515	1922	55,637	594,665			
1904	2,850	9,298	1923	73,963	946,643	Totals	1,986,973	$19,290,994
1905	3,933	16,221						

Table 62. Annual tonnage and value of mica produced in California, 1902-46

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2- or 3-year period (1929-31, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1902	50	$2,500	1934	0	0	1942	0	0
1903	50	3,800	1935-36	3,833	$15,650	1944-46	12,300	$65,850
1904	50	3,000	1937-38	4,969	31,751			
1929-31	2,240	15,260	1939	0	0	Totals	26,918	$162,824
1932-33	1,957	13,963	1940-41	1,469	11,050			

MAGNESITE

During 1946 no magnesite was reported produced in California. Both the mines in Santa Clara and Stanislaus Counties, which were in production for many years, were closed. Magnesia precipitated from sea water is replacing mined magnesite as a refractory in synthetic dead-burned magnesite, artificial periclase, and as a plastic in oxychloride cement.

The first commercial production of magnesite in California was made in the latter part of 1886 from the Cedar Mountain district,[7] southeast of Livermore, Alameda County. Shipments amounting to "several tons" or "several carloads" were sent by rail to New York; but there is apparently no exact record of the amount for that first year. The statistical records of the State Mining Bureau began with the year 1887, and the table herewith shows the figures for amount and value, annually, from that time. Shipments of magnesite from Napa County began in 1891 from the Snowflake mine; from the Red Mountain deposits in Santa Clara County, in 1899; and from Tulare County in 1900.

MICA

Bibliography: State Mineralogist Rept. 2, 4, 26-28 (inc.), 30, 33-36 (inc.); Bull. 38, 67, 91. U. S. Geol. Survey Bull. 740.

Sericite, a fine-grained variety of muscovite, has been produced continuously since 1929 in California except in 1934, 1939, 1942, and 1943. The 1946 shipments, consisting of sericite mica schist, came from a single property in Imperial County. The output was the largest ever reported in the state, both in tonnage and value.

The annual details are concealed in the *Unapportioned* item (table 40) so as not to reveal production of the individual operators. The material mined during the year was sericite. Sericite is used as a cheap grade of ground mica for roofing, as a refractory, foundry facing, and decorative material to imitate snow. A small amount of vermiculite, a hydrous mica, was mined in 1936. It is expanded by heating and then used as an insulating agent.

Practically all marketable mica is muscovite or phlogopite. There are three main commercial classes: sheet mica (including punch) splittings, and scrap. Sheet mica is used chiefly for electrical purposes and for glazing; splittings are made into built-up mica; scrap is ground to a powder. Mica to be classified as sheet must yield a rectangle of at least 1½ by 2 inches, must split evenly and freely, be free from cracks, rulings, or plications, and reasonably free from inclusions of foreign matter, though stains of a nonconducting character are permissible for some uses. Ability to withstand heat and high electrical resistance have led to a wide application of sheet mica in the electrical industries. The electrical uses of sheet mica greatly exceed all others in quantity and value.

As a heat-resisting transparent medium, sheet mica has various uses. It was widely employed for stove windows, though this use has declined to a considerable extent. A hard and rigid mica that is nearly clear is best suited for stove fronts. High-grade stove mica commands a higher price than electrical mica, because for the most part larger sizes are demanded. Mica is also used in furnace and bake-oven sight-holes, heat screens, lamp chimneys, canopies and shades, particularly for gas mantels; also for military lanterns, and in lantern slides.

[7] Mineral Resources U. S., 1886, pp. 6, 696.

Its ability to withstand shocks and strains, combined with its transparency, has led to wide use in spectacles, drivers' helmets, smoke helmets, compass cards, gage fronts, and in windows subject to shock, as in the conning towers of warships. On account of its heat-resisting qualities, ground mica is used in railroad-car axle packings, foundry facing in pipe and boiler coverings, in fireproof paints, and in rubber tires. Ground mica is used as a component in roofing, as a filler in rubber and other products, in foundry facing, calico printing and as a tire powder. It is used also in tinsel decorations, and as "Santa Claus snow" for Christmas tree and window decorations. It is used as a lubricant for wooden bearings, and mixed with oil for metal bearings.

Vermiculite is any one of several hydrous mica minerals which expand upon heating. In recent years it has become valuable for both heat and sound insulation. Another use is in window decorations where a golden or silver color is desired. These colors are often produced in hydrous mica by heat expansion.

MINERAL PAINT

Bibliography: State Mineralogist Rept. 12-19 (inc.), 21, 22-28 (inc.), 35, 37; Bull. 38, 91.

Mineral paints are minerals used as pigments, chiefly ocher, a mixture of iron oxides and clay, usually impure. The pigment mineral in brown and yellow ochers is usually limonite or goethite and in red ochers is hematite, but oxides of other metals are also used.

During 1946 in California shipments of mineral paint were made from a single property in San Bernardino County. The annual details are concealed under the *Unapportioned* item (table 40) so as not to reveal the output of the individual producer.

These materials have been reported from Alameda, Amador, Butte, Calaveras, Colusa, Los Angeles, Madera, Napa, Placer, Riverside, San Bernardino, Shasta, Sonoma, Stanislaus, and Ventura Counties. Other deposits may have value, but as yet there have been no commercial shipments from El Dorado, Imperial, Kern, Kings, Mendocino, San Diego, Siskiyou, Trinity, and Yuba Counties, in which they are found.

The first recorded production of mineral paint materials in the state was in the year 1890.

Table 63. Annual tonnage and value of mineral paint produced in California, 1890-1946

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2- or 3-year period (1927-28, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1890	40	$480	1907	250	$1,720	1923	1,049	$11,773
1891	22	880	1908	335	2,250	1924	532	5,234
1892	25	750	1909	305	2,325	1925	669	6,969
1893	590	26,795	1910	200	2,040	1926	569	5,846
1894	610	14,140	1911	186	1,184	1927-28	919	9,592
1895	750	8,425	1912	300	1,800	1929	467	2,820
1896	395	5,540	1913	303	1,780	1930-31	250	3,000
1897	578	8,165	1914	132	847	1932	0	0
1898	653	9,698	1915	311	1,756	1933-36	570	5,500
1899	1,704	20,294	1916	643	3,960	1937	855	5,193
1900	529	3,993	1917	520	2,700	1938	0	0
1901	325	875	1918	728	4,738	1941-42	145	1,458
1902	589	1,533	1919	1,780	17,055	1943-44	590	7,700
1903	2,370	3,720	1920	779	8,477	1945-46	26	278
1904	270	1,985	1921	446	4,748			
1905	754	4,025	1922	1,620	13,277	Totals	25,933	$249,038
1906	250	1,720						

MINERAL WATER

Bibliography: State Mineralogist Rept. 6, 12-18 (inc.), 21-28 (inc.), 31-33 (inc.), 39. U. S. Geol. Survey Water-Supply Paper 338. U. S. Dept. Agriculture, Bur. Chemistry, Bull. 91.

The annual production figures for California mineral water refer to water actually bottled for sale, or for local consumption. Health and pleasure resorts are located at many of the springs. The waters of some of the hot springs are not suitable for drinking, but are very efficacious for bathing. California is particularly rich in mineral springs.

The commercial output of mineral water in California during 1946 amounted to a total of 33,397,902 gallons worth $1,132,399, compared with 26,502,875 gallons worth $798,430 in 1945. The 1946 output came from springs or wells on thirty properties in nineteen counties, of which eight properties were in Los Angeles County; three in Lake County; two each in Contra Costa and Napa Counties; and one property each in Butte, Calaveras, Marin, Orange, Riverside, San Benito, San Bernardino, San Diego, San Francisco, San Luis Obispo, Santa Barbara, Shasta, Siskiyou, Sonoma, and Tehama Counties.

The production shown in table 64 came either from springs or artesian wells and was bottled, in part with artificial carbonation, but mostly natural, and sold for drinking purposes. A large part was used in the preparation of soft drinks with flavors.

Table 64. Production of mineral water during 1946, by county

NOTE: Where necessary in order to conceal output of individual producer in a county, production figures have been combined under "Unapportioned."

County	Gallons	Value
Lake	6,369	$1,957
Los Angeles	15,981,331	552,397
Unapportioned	17,410,202	578,045
Totals	33,397,902	$1,132,399

Table 65. Annual amount and value of mineral water produced in California, 1887-1946

Year	Gallons	Value	Year	Gallons	Value	Year	Gallons	Value
1887	618,162	$144,368	1908	2,789,715	$560,507	1929	27,032,083	$2,040,615
1888	1,112,202	252,990	1909	2,449,834	465,488	1930	37,354,111	2,870,663
1889	808,625	252,241	1910	2,335,259	522,009	1931	26,164,331	1,347,860
1890	258,722	89,786	1911	2,637,669	590,654	1932	19,031,224	1,495,988
1891	334,553	139,959	1912	2,497,794	529,384	1933	15,650,406	719,746
1892	331,875	162,019	1913	2,350,792	599,748	1934	19,882,436	1,071,197
1893	383,179	90,667	1914	2,443,572	476,169	1935	16,659,254	940,333
1894	402,275	184,481	1915	2,274,267	467,738	1936	19,348,513	777,899
1895	701,397	291,500	1916	2,273,817	410,112	1937	18,309,729	1,130,810
1896	808,843	337,434	1917	1,942,020	340,566	1938	26,900,959	853,998
1897	1,508,192	345,863	1918	1,803,791	375,650	1939	16,678,741	735,988
1898	1,429,809	213,817	1919	2,233,842	340,117	1940	16,190,549	960,701
1899	1,338,537	406,691	1920	2,391,791	421,643	1941	17,746,256	988,520
1900	2,456,115	268,607	1921	3,446,278	367,476	1942	17,559,686	567,897
1901	1,555,328	559,057	1922	4,276,346	486,424	1943	22,022,314	814,700
1902	1,701,142	612,477	1923	5,487,276	616,919	1944	24,445,814	812,645
1903	2,056,340	558,201	1924	8,159,211	818,726	1945	26,502,875	798,430
1904	2,430,320	496,946	1925	12,115,072	1,230,455	1946	33,397,902	1,132,399
1905	2,194,150	538,700	1926	14,074,877	1,171,550			
1906	1,585,690	478,186	1927	16,644,423	1,487,183	Totals	547,498,596	$40,601,881
1907	2,924,269	544,016	1928	25,049,002	1,304,969			

Mineral water was bottled for sale at the Napa Soda Springs, Napa County, as early as 1856[8], and at other springs in California, notably The Geysers, Sonoma County, at early dates; but no production figures are available earlier than the year 1887.

PHOSPHATES

Bibliography: State Mineralogist Rept. 21, 40; Bull. 67, 91.

No commercial production of phosphates has been recorded from California, though occasional pockets of the lithium phosphate, amblygonite, $Li(AlF)PO_4$ have been found associated with gem tourmaline deposits in San Diego County. Such production has been classified under lithia. In 1938, recovery began on a commercial scale of sodium-lithium phosphate at the plant of the American Potash and Chemical Corporation, at Searles Lake, San Bernardino County. However, the product is sold for its lithium content rather than the phosphate, hence it is recorded under *Lithia.*

PUMICE, PUMICITE, AND PERLITE

Pumice, pumicite, and perlite are all derivatives of acid volcanic rocks. All three are usually found in the same general areas of comparatively recent volcanic activity. In California, these areas, in the order of magnitude of the present production of pumice, are: (1) Northern San Francisco Bay area, (principally Napa and Sonoma Counties); this area produced more than 40,000 tons of pumice in 1946; (2) Central Sierra foothill belt, (principally Madera, Fresno, and Calaveras Counties), which produced more than 26,000 tons in 1946; (3) Owens Valley or southeastern area, (principally Mono, Inyo, and Kern Counties), which in 1946 produced more than 20,000 tons; (4) Northern area, (Siskiyou and Modoc Counties), which in 1946 produced about 8000 tons of pumice.

The principal production of pumicite (more than 7,400 tons in 1946) is from the central foothill belt; production from the southeastern area is smaller. Perlite deposits are known in all of the areas with the exception of the central foothill belt; in addition, many occurrences of obsidian (including perlite) are known in San Bernardino, Riverside, Imperial and other counties.

The principal present use for pumice in California is as an inert lightweight aggregate in concrete and plaster. Minor uses are as abrasive powder (after grinding), as scouring bricks (in lump form); as insulating and fireproofing material; as catalyst carrier in the chemical industry; and as chicken litter and as soil conditioner.

Pumicite is used extensively as a fine abrasive, alone or as an ingredient in soaps and cleansing powders; as a pozzuolanic agent in concretes, where it replaces part of the cement and increases corrosion resistance of the concrete. Minor uses for pumicite are: in the chemical industry as an insecticide carrier (principally the very fine grain size pumicite from Friant); as a filler in paints, paper and rubber; as a filter-aid and as an absorbent material.

The industrial use of expanded obsidian (perlite) dates from about 1945 in California, and production is not yet on a volume basis; most consumption is for experimental use. Processed perlite is essentially a synthetic pumice and its properties can be modified to suit specific uses.

[8] Cronise, T. F., The natural wealth of California, p. 182, 1868.

Table 66. Production of pumice and pumicite during 1946, by counties

NOTE: Where necessary in order to conceal output of individual producer in a county, production figures have been combined under "Unapportioned".

County	Tons	Value
Inyo	8,496	$73,173
Madera	33,052	186,233
Modoc	1,945	12,075
Siskiyou	5,771	42,600
Unapportioned (Calaveras, Contra Costa, Kern, Mono, Napa)	59,927	226,730
Totals	109,191	$540,811

In the future, perlite will undoubtedly be produced in large volume in various types suitable for all of the industrial uses of pumice and pumicite, and can be expected to enter other fields of specialized use.

The pumice and pumicite reported produced in California during 1946 totaled 109,191 net tons valued at $540,811, of which 95,164 tons worth $371,068 was pumice from five properties in Madera County, four in Siskiyou County, three each in Inyo and Modoc Counties, two each in Contra Costa and Mono Counties, one each in Calaveras and Kern Counties; and 14,027 tons worth $169,743 of pumicite from two properties in Madera County and one in Kern County. The 1946 output was the largest for any year so far in California both in amount and value. Production in 1945 was 89,209 tons worth $461,022, of which 74,505 tons worth $309,277 was pumice and 14,704 tons worth $151,745 was pumicite.

Commercial production of pumice in California was first reported to the State Mining Bureau in 1909, then not again until 1912, since which year there has been an annual output, as indicated in table 67.

Because of accelerated growth of population and industry in California, demand for pumice, pumicite, and processed perlite products is growing rapidly in the construction, chemical, and other industries in the state. Principal consuming areas for these products are the Los Angeles area; the San Francisco Bay area; and the central valley area. Price of pumice (graded concrete or plaster aggregate) f.o.b. San Francisco Bay area, ranges from $4.00 to $8.00 per yard, depending on class of pumice, quantity, and other factors. Much of the pumice produced in Napa and Sonoma Counties is captive and is used in precast masonry by the operators of the pumice deposits. In the Los Angeles area, graded aggregate pumice sells for $4.00 to $6.00 per yard. Most of that used is shipped by rail or truck from the Owens Valley producing area, and very little of the production is captive. In the central valley area, practically

Table 67. Annual amount and value of pumice produced in California, 1909-46

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1909	50	$500	1923	2,936	$16,309	1936	17,132	$143,709
1910	0	0	1924	4,919	33,404	1937	10,392	79,005
1911	0	0	1925	5,319	32,937	1938	18,783	105,207
1912	100	2,500	1926	7,170	48,350	1939	41,109	159,951
1913	3,590	4,500	1927	13,779	168,896	1940	35,162	126,516
1914	50	1,000	1928	10,440	105,055	1941	85,309	283,663
1915	380	6,400	1929	10,449	76,123	1942	55,603	209,539
1916	1,246	18,092	1930	12,947	128,847	1943	21,154	142,665
1917	525	5,295	1931	11,711	108,130	1944	34,525	272,064
1918	2,114	28,669	1932	9,891	86,034	1945	89,209	461,022
1919	2,388	43,657	1933	8,243	61,067	1946	109,191	540,811
1920	1,537	25,890	1934	9,951	54,748			
1921	406	6,310	1935	14,890	87,055	Totals	652,213	$3,678,168
1922	613	4,248						

all of the pumice used in house and building construction is produced in the foothill belt. It is sold at from $2.00 to $6.00 per yard f.o.b. site depending on distance from market and grade of the pumice. Pumicite from the Friant area for use in the chemical industry (particle size 1 to 10 microns) sells at $12 to $16 per ton f.o.b. Friant. Other pumicite is sold at less than this price depending on type, location, and use. Crude perlite is sold at from $4.00 to $7.00 per ton f.o.b. quarry, depending on location and quality; or from $7.00 to $18.00 per ton f.o.b. Los Angeles or San Francisco Bay areas, depending on freight and other factors. Most of the so far insignificant perlite production is captive; processing firms own or lease deposits of the obsidian.

PYRITES

Bibliography: State Mineralogist Rept. 18, 19, 22, 25, 26, 30, 35, 39, 40, 42; Bull. 38, 91.

Large deposits of massive and disseminated pyrite occur in California. The Mountain Copper Company in Shasta County has been the only California producer recently. At their Hornet mine in Shasta County pyrite occurs in massive deposits affording cheap mining. It is reported to average about 50 percent sulphur and is shipped to manufacturers of sulphuric acid located near San Francisco Bay.

Pyrites is the name given the iron sulphide minerals such as pyrite, marcasite, and pyrrhotite. Pyrite and marcasite have the same chemical composition and when pure contain about 47 percent iron and 53 percent sulphur. Their chief use is in the manufacture of sulphuric acid, which is being used in increasing amounts on the west coast in the fertilizer, oil refining, and chemical industries. Operations in Alameda County formerly yielded large tonnages, but these have not been active for many years.

The pyrite shipped in California came from a single property, therefore the figures are concealed in the *Unapportioned* item (table 40) in order to conceal the output of the individual producer.

This does not include the large quantities of pyrite, chalcopyrite, and other sulphides which are otherwise treated for their valuable metal contents. Some sulphuric acid is annually made as a by-product in the course of roasting certain tonnages of Mother Lode auriferous concentrates while under treatment for their precious metal content.

Table 68. Annual tonnage and value of pyrites produced in California, 1898-1946

NOTE: Where necessary in order to conceal output of individual producer, production figures are combined to cover a 2-year period (1932-33, etc.), or omitted (1946).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1898	6,000	$30,000	1913	79,000	$218,537	1928	90,566	$400,627
1899	5,400	28,620	1914	79,267	230,058	1929	79,169	363,717
1900	3,642	21,133	1915	92,462	293,148	1930	39,958	194,228
1901	4,578	18,429	1916	120,525	372,969	1931	25,402	131,174
1902	17,525	60,306	1917	111,325	323,704	1932-33	72,271	297,832
1903	24,311	94,000	1918	128,329	425,012	1934-35	157,129	547,754
1904	15,043	62,992	1919	147,024	540,300	1936-37	155,107	541,915
1905	15,503	63,958	1920	146,001	530,581	1938-39	127,604	452,901
1906	46,689	145,895	1921	110,025	473,735	1940-41	167,711	598,870
1907	82,270	251,774	1922	151,381	570,425	1942-43	234,596	1,001,966
1908	107,081	610,335	1923	148,004	555,308	1944-45	204,170	816,680
1909	457,867	1,389,802	1924	124,214	517,835	1946	----------	----------
1910	42,621	179,862	1925	129,500	528,550			
1911	54,225	182,954	1926	100,896	466,088	Totals	4,105,173	$15,302,267
1912	69,872	203,470	1927	130,910	564,823			

SERPENTINE

Bibliography: State Mineralogist Rept. 15, 40; Bull. 38.

Serpentine has not been produced in California to a very large extent at any time. A single deposit, that on Santa Catalina Island, has yielded the principal output to date. Some material was shipped from there in 1917 and 1918, being the only output recorded since 1907. It was used for decorative building purposes and for electrical switchboards. As there was but a single operator, the figures were combined with those of marble output for those years.

The production of serpentine prior to 1919 was verde antique, used as an ornamental stone. In recent years experimental tests have proved several possible commercial applications to which the mineral might be put, such as admix in cement; in the manufacture of magnesium chemicals; in terrazzo; as a substitute for soapstone, and as a filler.

In 1945 a plant was built at Permanente, Santa Clara County, to manufacture a fertilizer called thermo-phos, by fusing phosphate rock and serpentine. This plant went into production in 1946, using phosphate rock from Idaho and serpentine mined in Santa Clara County.

Table 69. Annual amount and value of serpentine produced in California, 1895-1946

NOTE: Where necessary in order to conceal output of individual producer, production figures are combined to cover a 2-year period (1917-18, etc.) or omitted (1946).

Year	Cubic ft.	Value	Year	Cubic ft.	Value	Year	Cubic ft.	Value
1895	4,000	$4,000	1902	512	$5,065	1919-37	0	0
1896	1,500	6,000	1903	99	8 0	1938	*103	$620
1897	2,500	2,500	1904	200	2,310	1939-45	0	0
1898	750	3,000	1905	0	0	1946		
1899	500	2,000	1906	847	1,694			
1900	350	2,000	1907	1,000	3,000	Total value		$41,279
1901	89	890	1917-18	1,120	7,400			

* Tons.

SHALE OIL

Bibliography: State Mineralogist Rept. 19. U. S. Geol. Survey Bull. 322, 729. U. S. Bur. Mines Bull. 210. Eng. and Min. Jour. Press, vol. 118, no. 8, pp. 290-292, Aug. 23, 1924. Chem. and Met. Eng., vol 32, no. 6, Feb. 1925. Min. Cong. Jour., Dec. 1924.

Two plants for the production of shale oil on a more or less experimental scale operated for 6 years in California, commercial production beginning in a small way in 1922. The product, in part, was sold for utilization as a flotation oil in metallurgical work, and part consumed as fuel at the plants. No production has been reported since 1927.

Table 70. Annual amount and value of shale oil produced in California, 1922-28

NOTE: Where necessary in order to conceal output of individual producer, production figures are combined to cover a 2-year period (1922-23, etc.).

Year	Barrels	Value
1922-23	4,333	$44,262
1924-25	8,688	55,240
1926-27	8,819	9,998
1928	0	0
Totals	21,840	$109,500

SILICA

Bibliography: State Mineralogist Rept. 9, 14, 15, 17, 18, 20-28 (inc.), 31-32 (inc.), 35-41 (inc.); Bull. 38, 67, 91.

California has large potential reserves of quartz, but most of the deposits are so situated that exploitation is economically impractical at present prices of $2.50 to $5.00 per ton f.o.b. plant for crude crushed quartz. Large and accessible deposits of high-grade glass sand are not known in California, but large reserves of lower grade sands suitable for glass making after processing are known. Further expansion of the glass industry in the state will result in the exploitation of these deposits, with consequent emphasis on research into economical methods of removing the impurities present either by washing, tabling, magnetic separation, flotation, acid-bath, or combinations of these and other processes.

Reserves of siliceous rock and sand suitable for refractory use in ganister and silica brick, and for use as molding sand are abundant in California, and the production of these materials is a rapidly growing industry. However, no open price schedule exists for glass sand, ganister rock, quartz, or molding sand, as production of these materials is made largely from owned or leased deposits by users of these materials, and prices are those fixed for the convenience of bookkeeping.

Silica is the principal constituent of many natural sands, but in this paper the special uses of silica in glass, ceramics, chemicals, refractories, and as a filler are considered separately from the common sand used in concrete and plaster. Such special uses have increased greatly in the past few years. Quartz and glass-sand production has increased from 70,835 tons valued at $297,272 in 1935 to 594,155 tons worth $1,408,553 in 1946. Most of this large increase is the result of the expansion of the glass industry in California in recent years, and present indications are that the demand for glass sand and quartz is increasing.

The silica shipped in California during 1946 came from eight properties. Glass sand came from two properties in Monterey County and one each in Contra Costa, Riverside, and San Diego Counties. Quartz came from two properties in San Bernardino County and one in Mariposa County. In 1945 shipments of silica totaled 581,725 tons worth $1,309,564.

Silica sand has been produced in the following counties of the state: Alameda, Amador, Contra Costa, El Dorado, Imperial, Inyo, Los Angeles,

Table 71. Annual tonnage and value of silica (chiefly sand) produced in California, 1899-1946

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1899	3,000	$3,500	1916	20,880	$48,908	1933	70,329	$266,520
1900	2,200	2,200	1917	19,376	41,166	1934	70,432	296,643
1901	5,000	16,250	1918	23,257	88,930	1935	70,835	297,272
1902	4,500	12,225	1919	18,659	101,600	1936	77,830	310,278
1903	7,725	7,525	1920	25,324	96,793	1937	84,313	348,987
1904	10,004	12,276	1921	10,569	49,179	1938	63,167	278,676
1905	9,257	8,121	1922	9,874	31,016	1939	86,229	349,074
1906	9,750	13,375	1923	7,964	30,420	1940	101,041	376,723
1907	11,065	8,178	1924	6,808	35,006	1941	137,660	514,266
1908	9,255	22,045	1925	12,498	96,780	1942	193,174	692,762
1909	12,259	25,517	1926	30,010	104,317	1943	161,318	533,434
1910	19,224	18,265	1927	24,636	94,762	1944	274,291	830,311
1911	8,620	8,672	1928	14,814	66,679	1945	581,725	1,309,564
1912	13,075	15,404	1929	18,686	79,210	1946	594,155	1,408,553
1913	18,618	21,899	1930	17,802	71,380			
1914	28,538	22,688	1931	43,330	182,769	Totals	3,105,977	$9,410,764
1915	28,904	34,322	1932	33,997	136,324			

Mariposa, Mono, Monterey, Orange, Placer, Riverside, San Bernardino, San Diego, San Joaquin and Tulare, the chief centers being Contra Costa, Monterey, Riverside, and San Bernardino Counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass; for such, it must be essentially iron-free. Even a fraction of a percent of iron imparts a green color to the glass.

The marketing of silica and prices prevailing in California for commercial types of silica sand and fusing quartz are based upon individual contract negotiation between buyer and seller. California glass sand suitable for container glass but not for high-grade flat glass, is sold at $2.00 to $3.00 per ton, f.o.b. California points. A better grade of glass sand produced in Nevada is sold at $6.50 to $8.50 per ton, washed and drained, f.o.b. Los Angeles. Freight from Nevada to Los Angeles is $2.70 per ton. Ottawa, Illinois, and Missouri high-grade glass sand sells at $11.40 to $12.65 per ton, f.o.b. California points, crude and dried. Freight is $9.13 per ton. Belgian glass sand has sold in the past in California as low as $5.00 per ton f.o.b. California ports, but no imports have been made in recent years.

Ground silica flour sells at $19.00 to $23.00 per ton, f.o.b. California points, depending on grade. A small tonnage of quartz for chemical and ferrosilicon manufacture is sold in the state at $2.50 to $3.50 per ton, f.o.b. car, mine.

SILLIMANITE GROUP[9]

(Andalusite, Kyanite and Dumortierite)

Production of andalusite and kyanite previous to 1945 was approximately 2000 tons per year. In 1945, Champion Spark Plug Company ceased work at its andalusite deposit in Dry Creek Canyon in the White Mountains, Mono County, and all equipment was sold. The Vitrefrax Corporation of Los Angeles, owner and operator of a kyanite deposit near Ogilby, Imperial County, also suspended operations and liquidated its plant in Los Angeles. The outlook for any production of andalusite or kyanite is not favorable for 1947.

Table 72. Tonnage and value of sillimanite-group minerals produced in California, 1922-46

NOTE: Where necessary in order to conceal output of individual producer, production figures are combined to cover a 2- or 3-year period (1922-24, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1922-24	4,584	$98,790	1933-34	3,035	$69,026	1944-45	2,390	$38,713
1925-26	4,810	203,000	1935-36	3,112	89,214	1946	126	1,260
1927-28	4,276	76,000	1937-38	2,681	70,477			
1929-30	4,359	198,893	1940-41	1,344	23,391	Totals	36,007	$969,919
1931-32	1,244	21,800	1942-43	4,046	79,355			

STONE FOR MONUMENTS AND BUILDINGS[10]

Immense reserves and a large variety of building stones occur in California. Granite, marble, sandstone, slate, diorite, granodiorite, and numerous volcanic rocks, including tuff, have been quarried in the state in large amounts for buildings and monuments. Years ago, dimension

[9] See also Jeffery, J. A., The sillimanite group of minerals: California Jour. Mines and Geology, vol. 39, pp. 383-390, 1943.

[10] See also Galliher, W. E., Geology and physical properties of building stone from Carmel Valley, California: California Div. Mines Rept. 28, pp. 14-41, 1932.

Table 73. Annual value of granite produced in California, 1887-1946

Year	Value	Year	Value	Year	Value	Year	Value
1887	$150,000	1903	$678,670	1919	$220,743	1935	$339,917
1888	57,000	1904	467,472	1920	495,732	1936	244,243
1889	1,329,018	1905	353,837	1921	725,901	1937	207,738
1890	1,200,000	1906	344,083	1922	676,643	1938	131,386
1891	1,300,000	1907	373,376	1923	760,081	1939	145,194
1892	1,000,000	1908	512,923	1924	1,211,046	1940	198,896
1893	531,322	1909	376,834	1925	1,853,859	1941	261,661
1894	228,816	1910	417,898	1926	655,332	1942	186,872
1895	224,329	1911	355,742	1927	1,398,443	1943	148,160
1896	201,004	1912	362,975	1928	763,996	1944	222,843
1897	188,024	1913	981,277	1929	1,169,271	1945	220,411
1898	147,732	1914	628,786	1930	855,477	1946	275,367
1899	141,070	1915	227,928	1931	636,741		
1900	295,772	1916	535,339	1932	398,676	Total value	$29,585,027
1901	519,285	1917	221,997	1933	183,706		
1902	255,239	1918	139,861	1934	249,083		

Table 74. Annual amount and value of marble produced in California, 1887-1946

(No records were kept from 1887-93 to show the number of cubic feet of marble produced; from 1935-46 some production was reported in tons, and some in cubic feet, so that only the value is tabulated herein. Figures for 1920, 1924, and 1927-46 include onyx and travertine; figures for 1919 and 1938 include onyx and serpentine; figures for 1887 include onyx.)

Year	Cubic ft.	Value	Year	Cubic ft.	Value	Year	Cubic ft.	Value
1887	----------	$5,000	1908	18,653	$47,665	1929	72,881	$93,661
1888	----------	5,000	1909	79,600	238,400	1930	65,775	82,194
1889	----------	87,030	1910	18,960	50,200	1931	37,776	81,760
1890	----------	80,000	1911	20,201	54,103	1932	25,506	42,505
1891	----------	100,000	1912	27,820	74,120	1933	9,039	23,178
1892	----------	115,000	1913	41,654	113,282	1934	7,185	10,759
1893	----------	40,000	1914	25,436	48,832	1935	----------	9,884
1894	38,441	98,326	1915	22,186	41,518	1936	----------	23,011
1895	14,864	56,566	1916	25,954	50,280	1937	----------	23,667
1896	7,889	32,415	1917	24,755	62,950	1938	----------	6,015
1897	4,102	7,280	1918	17,428	49,898	1939	----------	14,822
1898	8,050	23,594	1919	25,020	74,482	1940	----------	15,189
1899	9,682	10,550	1920	29,531	92,899	1941	----------	14,448
1900	4,103	5,891	1921	30,232	98,395	1942	----------	580
1901	2,945	4,630	1922	38,321	127,792	1943	0	0
1902	19,305	37,616	1923	28,015	124,919	1944	----------	8,800
1903	84,624	97,354	1924	61,579	140,253	1945	0	0
1904	55,401	94,208	1925	35,664	116,105	1946	----------	1,535
1905	73,303	129,450	1926	34,806	119,999			
1906	31,400	75,800	1927	42,308	103,689	Total value	----------	$3,587,755
1907	37,512	118,066	1928	34,324	82,190			

Table 75. Annual value of onyx produced in California, 1887-1926

(Figures for the years 1887, 1919, 1924, and 1927-46 included under marble.)

Year	Value	Year	Value	Year	Value	Year	Value
1887	----------	1893	$1,800	1919	----------	1924	----------
1888	$900	1894	27,000	1920	0	1925	$16,120
1889	900	1895	20,000	1921	$1,294	1926	7,575
1890	900	1896	12,000	1922	3,320		
1891	1,500	1918	24,000	1923	2,510	Total value	$122,219
1892	2,400						

stone was used in buildings to the amount of roughly $1,000,000 annually, but this use has been largely displaced by concrete. Most of the granite now quarried is used for monuments and comes from Fresno, Lassen, Placer, San Bernardino, and San Diego Counties. Small amounts of marble are produced in San Luis Obispo and San Bernardino Counties. Large reserves of this stone still exist in many other counties. Sandstone and various types of volcanic rocks that break into flat slabs are in considerable demand for flagstone, garden construction, and decorative veneers on the fronts of buildings. Many such stones have a distinctive color, which adds to the value. Such stone is produced in Napa, Monterey, and Santa Barbara Counties.

Granite

The granite output in California during 1946 was valued at $275,367 compared with $220,411 in 1945. The 1946 production consisted of 29,875 cubic feet of monumental and building stone, worth $266,581; a small amount of curbing, and some tuff and volcanic rock used in building and as flagstone. The granite came from two quarries in San Diego County, and one quarry each in Fresno, Lassen, Placer, Riverside, and San Bernardino Counties, and tuff from Sonoma County.

For building purposes, the granite found in California, particularly the varieties from Raymond in Madera County, Rocklin in Placer County, and near Porterville in Tulare County, are unexcelled by any similar stone found elsewhere. The quantities available, notably at Raymond and Porterville, are unlimited. Most of California's "granite," particularly that found in the Sierra Nevada, is technically granodiorite.

Granites of excellent quality for building and ornamental purposes are also quarried in Riverside, San Bernardino, and San Diego Counties. Near Lakeside, San Diego County, is a fine-grained, "silver-gray" granite of uniform texture and color, especially suited for monumental and ornamental work.

The Fresno County stone is a dark hornblende diorite, locally called "black granite," whose color permits a fine contrast of polished and unpolished surfaces, making it particularly suitable for monumental and decorative purposes. Similar "black granite" occurs in Tulare County, near Success.

Marble

The material classed under marble shipped in California during 1946 totaled 129 tons valued at $1,535. It consisted of onyx marble from one quarry in San Bernardino County and limestone used as a building stone from one property each in San Bernardino and San Luis Obispo Counties. In 1943 and 1945 no marble was reported quarried in California. These were the only years that no output was reported since 1887, when the first record of the marble industry was made in the state. In 1944 a production was reported from a single property in Inyo County.

California has many beautiful and serviceable varieties of marble, suitable for almost any conceivable purpose of construction or decoration. In the decorative class are deposits of onyx marble of beautiful coloring and effect. Serpentine "marble" suitable for electrical switchboards is available also.

Onyx and Travertine

Onyx and travertine are known to exist in a number of places in California, but only a small and irregular production has been made since the year 1896.

During 1946 a small production of onyx was reported from a property in San Bernardino County. This material is used in terrazzo and for ornamental purposes.

Sandstone

The production of sandstone in California reported during 1946 totaled 2,286 tons or approximately 32,000 cubic feet valued at $25,764, from two quarries in Monterey County and one each in Los Angeles, Napa, and Santa Barbara Counties.

Practically all of the material was flagstone used in garden walks, fountains, walls, and fireplaces, to give effect to Spanish and English type homes. The material reported from Monterey and San Luis Obispo Counties is in reality cream-colored indurated Monterey shale; it is utilized as a building stone. That from Ventura County is a red shale.

Table 76. Annual amount and value of sandstone produced in California, 1887-1946

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1943-44).

Year	Cubic ft.	Value	Year	Cubic ft.	Value	Year	Cubic ft.	Value
1887	----------	$175,000	1908	93,301	$55,151	1929	177,655	$49,881
1888	----------	150,000	1909	79,240	37,032	1930	160,704	56,404
1889	----------	175,598	1910	165,971	80,443	1931	110,244	30,960
1890	----------	100,000	1911	255,313	127,314	1932	41,793	13,286
1891	----------	100,000	1912	66,487	22,574	1933	25,980	10,888
1892	----------	50,000	1913	62,227	27,870	1934	21,738	14,245
1893	----------	26,314	1914	111,691	45,322	1935	38,426	9,268
1894	----------	113,592	1915	63,350	8,438	1936	24,705	9,180
1895	----------	35,373	1916	17,270	10,271	1937	73,190	15,680
1896	----------	28,379	1917	31,090	7,074	1938	43,107	9,384
1897	----------	24,086	1918	900	400	1939	54,380	12,494
1898	----------	46,384	1919	5,400	3,720	1940	27,992	13,083
1899	56,264	103,384	1920	10,500	2,300	1941	60,958	13,143
1900	378,468	254,140	1921	10,150	2,112	1942	20,427	8,587
1901	266,741	192,132	1922	900	1,100	1943-44	30,672	7,415
1902	212,123	142,506	1923	7,000	13,000	1945	25,758	7,498
1903	353,002	585,309	1924	6,700	3,600	1946	32,000	25,764
1904	363,487	567,181	1925	14,704	14,362			
1905	302,813	483,268	1926	34,100	17,500	Total value	----------	$4,700,255
1906	182,076	164,068	1927	222,900	205,400			
1907	159,573	148,148	1928	134,100	43,250			

Table 77. Annual amount and value of slate produced in California, 1889-1946

(No quantity is shown for the years 1926 and 1935-37, as production was in some cases reported as squares and in some cases as tons. Otherwise, quantity of production, 1889-1926, inclusive, is in squares; 1927-46, inclusive, in tons.) NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1929-30, etc.).

Year	Squares	Value	Year	Squares	Value	Year	Tons	Value
1889	4,500	$18,089	1904	6,000	$50,000	1927	2,686	$17,960
1890	4,000	24,000	1905	4,000	40,000	1928	4,075	31,263
1891	4,000	24,000	1906	10,000	100,000	1929-30	8,220	71,347
1892	3,500	21,000	1907	7,000	60,000	1931-32	8,234	55,182
1893	3,000	21,000	1908	6,000	60,000	1933	5,343	31,958
1894	1,800	11,700	1909	6,961	45,660	1934	5,065	24,245
1895	1,350	9,450	1910	1,000	8,000	1935	----------	40,912
1896	500	2,500	1911	0	0	1936	----------	49,818
1897	400	2,800	1915	1,000	5,000	1937	----------	32,572
1898	400	2,800	1916	0	0	1938	6,871	30,281
1899	810	5,900	1920	8	80	1939	5,777	28,327
1900	3,500	26,250	1921	0	0	1940	4,777	18,031
1901	5,100	38,250	1922	200	2,400	1941-42	16,596	80,321
1902	4,000	30,000	1923	0	0	1943-44	17,309	102,851
1903	10,000	70,000	1926	----------	7,371	1945-46	14,879	100,099
						Total value	----------	$1,420,017

Slate

Slate was first produced in California in 1889. Up to and including 1910 production was continuous, but since then it has been irregular. Large deposits of excellent quality are known in the state, especially in El Dorado, Calaveras, and Mariposa Counties, but the demand has been light owing principally to competition of cheaper roofing materials.

The 1946 production of slate in California came from a single property each in El Dorado and Placer Counties; the material from El Dorado County was ground for roofing granules and the fines used as a filler; that from Placer County was sold in thin flat pieces to be used as facing on the outside of buildings. The 1946 output showed an increase in amount and value when compared with that of 1945.

STONE, MISCELLANEOUS

Stone for road surfacing and concrete aggregate has been produced in every county in California; such material has a wide variety of other uses. Great irregular chunks of 10 tons each, known as riprap, are dumped from barges into shallow parts of bays to form the sea-walls behind which sand and mud are pumped to reclaim land. Small sizes of rock are used for railroad ballast, and the accompanying finely divided material is used in concrete and plasters. Certain types of sand are mined especially for making molds in foundries.

Many different types of stone are used; also there are many ways of producing it. The 10-ton chunks of riprap are blasted from solid bodies of basalt and granite. One of the largest granite quarries is located near the San Andreas fault, where the faulting has crushed the granite so that the amount of explosives needed is much lower than average. In Butte and Sacramento Counties, crushed rock is produced from old dredge-tailing; thus the waste from the gold-dredging industry becomes the valuable raw material of the crushed-rock industry. A favorite method for producing sand and gravel is to excavate the bars along streams with various types of dragline excavators. The pits thus formed are sometimes re-filled by winter floods. Nature has had a part in improving the quality of this material; soft decomposed rocks have been pounded and pulverized and washed away as mud; the harder,

Table 78. Annual tonnage and value of crushed rock, sand, and gravel produced in California, 1893-1946

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1893	371,000	$456,075	1912	8,044,937	$4,532,598	1931	15,848,313	$11,848,531
1894	661,900	664,838	1913	9,817,616	4,823,056	1932	11,361,564	7,183,643
1895	1,254,688	1,095,939	1914	9,288,397	3,960,973	1933	11,181,156	6,871,581
1896	960,619	839,884	1915	10,879,497	4,609,278	1934	16,148,275	7,131,330
1897	821,123	600,112	1916	9,951,089	4,009,590	1935	9,041,876	5,571,041
1898	1,177,365	814,477	1917	8,069,271	3,505,662	1936	23,528,079	16,578,238
1899	964,898	786,892	1918	6,641,144	3,325,889	1937	28,254,740	16,917,683
1900	789,287	561,642	1919	6,919,188	3,678,322	1938	19,051,677	11,734,038
1901	530,396	641,037	1920	9,792,122	6,782,414	1939	18,693,896	10,316,787
1902	2,056,015	1,249,529	1921	10,914,145	7,834,640	1940	24,184,186	12,181,564
1903	2,215,625	1,673,591	1922	13,049,644	10,366,231	1941	34,626,035	19,559,883
1904	2,296,898	1,641,877	1923	19,840,301	15,379,838	1942	45,455,085	27,281,342
1905	2,624,257	1,716,770	1924	21,451,129	15,962,476	1943	32,599,432	21,716,223
1906	1,555,372	1,418,406	1925	23,819,137	17,407,113	1944	35,370,143	25,138,003
1907	2,288,888	1,915,015	1926	24,987,606	19,859,261	1945	29,449,484	20,207,351
1908	3,993,945	3,241,774	1927	25,126,691	18,912,994	1946	41,610,212	27,671,788
1909	5,531,561	2,708,326	1928	27,471,794	17,328,044			
1910	5,827,828	2,777,690	1929	27,104,618	17,840,159	Totals	740,500,535	$472,862,822
1911	6,487,223	3,610,357	1930	23,514,168	16,430,027			

Table 79. Production of sand and gravel during 1946, by county

(Includes molding sand in Contra Costa, Los Angeles, Monterey, Orange, Sacramento, San Diego, San Mateo, and Ventura Counties; also filter sand and blast sand in San Diego County.) NOTE: Where necessary in order to conceal output of individual producer in a county, production figures are combined under "Unapportioned."

County	Tons	Value	County	Tons	Value
Alameda	3,444,672	$2,434,148	Sacramento	1,210,514	$822,279
Butte	40,936	27,173	San Bernardino	926,594	657,577
Calaveras	26,121	23,621	San Diego	921,911	988,755
Colusa	155,829	54,840	San Joaquin	1,001,433	684,182
Contra Costa	297,245	184,451	Santa Barbara	35,498	19,469
Del Norte	53,405	66,565	Santa Clara	256,462	200,729
El Dorado	42,500	15,625	Shasta	367,346	160,596
Fresno	700,095	479,931	Siskiyou	163,460	198,137
Glenn	99,100	57,390	Stanislaus	324,175	219,863
Humboldt	232,041	225,170	Tulare	163,806	115,503
Imperial	133,215	136,300	Ventura	453,195	365,968
Inyo	39,978	18,312	Yolo	280,782	155,930
Kern	373,701	266,759	Yuba	283,408	196,987
Lake	156,243	100,893	Unapportioned (Alpine, Amador, Madera, Marin, Mariposa, Modoc, Mono, Napa, Nevada, San Benito, San Luis Obispo, San Mateo, Santa Cruz, Sierra, Sonoma, Tehama, Trinity, Tuolumne)	1,429,285	1,161,348
Lassen	35,109	17,200			
Los Angeles	9,269,540	4,707,626			
Mendocino	206,738	286,958			
Merced	286,292	189,935			
Monterey	352,649	225,775			
Orange	669,459	469,408			
Placer	15,122	6,208			
Plumas	64,800	63,000			
Riverside	449,608	300,611	Totals	24,962,267	$16,305,222

more resistant rocks remain. In some plants the sand and gravel are washed and separated into various sizes by screens only, but most plants contain crushers to reduce the size of cobbles and boulders.

Concrete highways, dams, aqueducts, and canals require great quantities of sand, gravel, and crushed rock for aggregate. As long as this type of construction continues at a high level, the stone industry will continue to hum. Smaller quantities of such material go into foundations, walls, and floors of buildings. In a few places limestone is quarried for surfacing roads.

The total tonnage of miscellaneous stone, including sand, gravel, crushed rock, rubble, and riprap in California as reported by producers was 41,610,212 tons valued at $27,671,788 in 1946, compared with 29,449,484 tons worth $20,207,351 in 1945.

Los Angeles led all other counties during 1946 in the value of its miscellaneous-stone output, which was $6,100,968; Alameda was second with an output worth $3,120,783; San Mateo third with an output worth $2,965,755; these were followed in turn by Sacramento, San Diego, and San Bernardino, all having an output in excess of a million dollars. All other counties with the exception of Kings and Sutter contributed to the overall figures in 1946.

The amount and value, annually, of crushed rock (including macadam, ballast, rubble, riprap, and that used in concrete), sand and gravel produced since 1893, are shown in table 78.

A comparison of table 78, which shows annual production of crushed rock, sand, and gravel, with table 46, which shows annual production of cement, reveals the fact that the important growth of the crushed rock and gravel business was coincident with the rapid development of the cement industry, from the year 1902.

Crushed Rock

To list the kinds and varieties of rock utilized commercially under this heading would be to run almost the entire gamut of the classification scale. Much depends on the kind available in a given district. Those which give the most satisfactory service are the basalts and other hard, dense, igneous rocks which break with sharp, clean edges. In many localities, river-wash boulders form an important source of such material. In such cases, combined crushing and washing plants obtain varying amounts of sand and gravel along with the crushed sizes.

During 1946 a total of 16,647,945 tons of crushed rock, rubble, and riprap worth $11,366,566 were produced, of which 3,399,439 tons worth $2,932,236 were reported used as macadam and ballast; 533,524 tons worth $602,144 were used for rubble and riprap; 1,175,854 tons worth $993,628 were used in concrete; and 11,539,128 tons worth $6,838,558 were listed as unclassified. The 1946 output showed an increase in both amount and value as compared with that of 1945, which was 13,120,464 tons worth $9,835,704.

Sand and Gravel

A considerable part of the gravel excavated is passed through grading and washing plants, and the material over 2 inches in size is crushed. Much of it is utilized in concrete mixtures. Most of the gravel used for road surfacing and repairs as well as that for railroad ballast is creek-run or pit-run material which is spread upon the roads without undergoing any grading or washing.

The sand and gravel produced in 1946 totaled 24,962,267 tons worth $16,305,222, as compared with 16,329,020 tons worth $10,371,647 in 1945.

Included in the 1946 figures are 72,226 tons of molding sand worth $254,396, which came from a single property each in Contra Costa, Los Angeles, Monterey, Orange, Sacramento, San Diego, San Mateo, and Ventura Counties. The 1946 output of molding sand showed an increase over that for 1945, which totaled 44,447 tons, worth $155,567.

Grinding-Mill Pebbles

The 1946 output of grinding-mill pebbles in California came from a single property in San Diego County. The 1946 production was a decrease in amount and value as compared with that of 1945, which came from a property in San Diego County.

Paving Blocks

During 1946 no production of paving blocks was reported in California. The 1943 output came from a single quarry in Sacramento County. The paving-block industry has decreased materially in recent years, practically to the vanishing point, because of the increased construction of smoother pavements demanded by motor vehicle traffic. The blocks made in Solano County were of basalt; those from Sonoma were of basalt, andesite, and some trachyte, whereas those from Madera, Placer, Riverside, San Bernardino, and San Diego were of granite; those from San Mateo County were of sandstone.

Table 80. Production of crushed rock during 1946, by county

County	Macadam and ballast		Rubble and riprap		For concrete	
	Tons	Value	Tons	Value	Tons	Value
Alameda	164,311	$155,100	11,814	$12,595	76,498	$73,053
Butte	*	*			*	*
Contra Costa	*	*	*	*	*	*
El Dorado	63,166	74,446	*	*	*	*
Fresno	[a]63,881	45,235			73,607	82,426
Humboldt	20,075	17,411	*	*		
Kern	[a]86,000	43,000			*	*
Lassen	*	*				
Los Angeles	*	*			*	*
Mendocino						
Modoc	[c]65,730	59,263				
Mono	[a]8,100	5,078				
Nevada	9,000	22,500				
Orange						
Placer	20,090	30,135				
Plumas	[a]108,647	113,999				
Riverside			32,703	56,830	*	*
Sacramento	228,253	197,057	*	*		
San Bernardino	227,311	159,452			78,077	77,162
San Diego	[a]18,785	14,404	3,268	12,204	*	*
San Mateo	119,253	115,040	7,332	11,000	*	*
Santa Barbara	18,000	18,000				
Santa Clara	364,392	235,124				
Shasta	119,981	120,756			*	*
Siskiyou	[c]220,950	76,983				
Trinity	[a]2,600	1,000	19,820	18,529		
Tulare					62,120	73,693
Tuolumne	*	*	*	*		
Yolo	32,004	48,006				
Yuba						
Amador, Butte, Contra Costa, Lassen, Los Angeles[a], Marin, Napa, San Benito, Sonoma, Tuolumne, and Ventura Counties	1,438,910	1,380,247				
El Dorado, Fresno, Humboldt, Marin, Sacramento, San Benito, Santa Cruz, Sonoma, and Tuolumne Counties			458,587	490,986		
Butte, Contra Costa, El Dorado, Kern, Los Angeles, Riverside, San Benito, San Diego, San Joaquin, San Mateo, Shasta, Tehama, Tuolumne, and Ventura Counties					885,552	687,294
Amador[b], El Dorado, Kern, Marin, San Benito, San Diego, San Francisco, San Joaquin, Santa Cruz, Shasta, Solano, Sonoma, and Tehama Counties						
Totals	3,399,439	$2,932,236	533,524	$602,144	1,175,854	$993,628

Table 80. Production of crushed rock during 1946, by county—Continued

County	Unclassified		Total	
	Tons	Value	Tons	Value
Alameda	[d]762,859	$445,887	1,015,482	$686,635
Butte	128,087	99,061	128,087	99,061
Contra Costa	241,874	238,730	241,874	238,730
El Dorado	*	*	63,166	74,446
Fresno	61,416	69,812	198,904	197,473
Humboldt	410	410	20,485	17,821
Kern	*	*	86,000	43,000
Lassen	[a]41,975	34,906	41,975	34,906
Los Angeles	[a]2,514,066	1,098,023	2,514,066	1,098,023
Mendocino	6,548	20,015	6,548	20,015
Modoc			65,730	59,263
Mono			8,100	5,078
Nevada			9,000	22,500
Orange	157,909	137,652	157,909	137,652
Placer			20,090	30,135
Plumas			108,647	113,999
Riverside	[d]150,349	39,943	183,052	96,773
Sacramento	456,328	350,949	684,581	548,006
San Bernardino	[a]353,400	111,120	658,788	347,734
San Diego	*	*	22,053	26,608
San Mateo	[c]5,073,695	2,792,426	5,200,280	2,918,466
Santa Barbara			18,000	18,000
Santa Clara	377,110	340,772	741,502	575,896
Shasta	*	*	119,981	120,756
Siskiyou			220,950	76,983
Trinity	1,050	525	23,470	20,054
Tulare	13,000	18,200	75,120	91,893
Tuolumne	[d]15,000	40,000	15,000	40,000
Yolo			32,004	48,006
Yuba	76,130	41,195	76,130	41,195
Amador, Butte, Contra Costa, Lassen, Los Angeles[a], Marin, Napa, San Benito, Sonoma, Tuolumne, and Ventura Counties			1,438,910	1,380,247
El Dorado, Fresno, Humboldt, Marin, Sacramento, San Benito, Santa Cruz, Sonoma, and Tuolumne Counties			458,587	490,986
Butte, Contra Costa, El Dorado, Kern, Los Angeles, Riverside, San Benito, San Diego, San Joaquin, San Mateo, Shasta, Tehama, Tuolumne, and Ventura Counties			885,552	687,294
Amador[b], El Dorado, Kern, Marin, San Benito, San Diego, San Francisco, San Joaquin, Santa Cruz, Shasta, Solano, Sonoma, and Tehama Counties	1,107,922	958,932	1,107,922	958,932
Totals	11,539,128	$6,838,558	16,647,945	$11,366,566

* Combined to conceal the output of operators in each.
[a] Includes decomposed granite.
[b] Includes slag.
[c] Includes volcanic cinders.
[d] Includes granules for roofing and terrazzo.
[e] Includes fill material.

Table 81. Annual tonnage and value of grinding-mill pebbles produced in California, 1915-46

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1929-30, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1915	340	$2,810	1924	434	$2,969	1935-36	961	$8,356
1916	20,232	107,567	1925	215	1,385	1937-38	960	4,800
1917	21,450	90,538	1926	102	612	1939-40	482	982
1918	8,628	61,268	1927	288	1,800	1941-42	573	2,650
1919	2,607	19,272	1928	372	2,408	1943-44	162	1,367
1920	2,104	17,988	1929-30	166	1,225	1945-46	299	3,107
1921	247	1,418	1931-32	25	211			
1922	1,571	7,628	1933-34	300	3,018	Totals	65,168	$358,315
1923	2,650	14,936						

Table 82. Annual amount and value of paving blocks produced in California, 1887-1944

(Figures for 1887-92, inclusive, represent production from Sonoma County only; quarries in Solano County were also active during this period, but production records are not available.) NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1930-31, etc.).

Year	Amount (M)	Value	Year	Amount (M)	Value	Year	Amount (M)	Value
1887	10,000	$350,000	1905	3,408	$134,347	1923	15	$880
1888	10,500	367,500	1906	4,203	173,432	1924	11	935
1889	7,303	297,236	1907	4,604	199,347	1925	27	1,350
1890	7,000	245,000	1908	7,660	334,780	1926	0	0
1891	5,000	150,000	1909	4,503	199,803	1927	41	2,057
1892	3,000	96,000	1910	4,434	198,916	1928	25	1,658
1893	2,770	96,950	1911	4,141	210,819	1929	0	0
1894	2,517	66,981	1912	11,018	578,355	1930-31	66	5,900
1895	2,332	73,338	1913	6,364	363,505	1932	0	0
1896	4,161	77,584	1914	6,053	270,598	1934	2	75
1897	1,711	35,235	1915	3,285	171,092	1935	0	0
1898	1,144	21,725	1916	1,322	54,362	1938-39	9	439
1899	305	7,861	1917	938	38,567	1940-41	155	30,862
1900	1,192	23,775	1918	372	17,000	1942-43	5	201
1901	1,920	41,075	1919	27	1,350	1944	0	0
1902	3,502	112,437	1920	63	3,155			
1903	4,854	134,642	1921	4	280	Totals	136,015	$5,712,288
1904	3,977	161,752	1922	72	3,924			

STRONTIUM

Bibliography: State Mineralogist Rept. 26, 27, 35, 36, 38, 39; Bull. 67, 91. U. S. Geol. Survey Bull. 540; 660-I.

Strontium occurs as the sulphate, celestite, and the carbonate, strontianite. Large undeveloped deposits of celestite occur as ancient lake deposits in San Bernardino, Imperial, and Inyo Counties. The production has been from Imperial and San Bernardino Counties. Properties recently operated are the Roberts deposit in Fish Mountains, Imperial County, and Rowe-Buehler deposit near Lavic, San Bernardino County.

The present output is less than 1000 tons per year, and owing to imports from England, any increase in production for 1947 is not probable. Possibly celestite will be used as a substitute for barite for oil-well drilling mud.

During 1945 and 1946 strontium minerals were mined and shipped from one property each in Imperial and San Bernardino Counties.

The first recorded commercial output of strontium minerals in California was in 1916. Shipments reported as averaging 80 percent $SrCO_3$ have been made, and both celestite ($SrSO_4$), the strontium sulphate, and strontianite ($SrCO_3$), the strontium carbonate, have been produced com-

Table 83. Annual tonnage and value of strontium minerals produced in California, 1916-46

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1941-42, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1916	57	$2,850	1939	2	$82	1945-46	207	$5,165
1917	3,050	37,000	1940	627	8,686			
1918	2,900	33,000	1941-42	5,671	83,069	Totals	15,014	$212,258
1919	0	0	1943-44	2,500	42,406			

mercially in this state. The deposit is associated with deposits of barite near Barstow, San Bernardino County. The carbonate has also been found in massive form near Shoshone, Inyo County. In addition to Imperial County, celestite is found near Calico and Ludlow, and in the Avawatz Mountains in San Bernardino County, but is as yet undeveloped.

SULPHUR

Bibliography: State Mineralogist Rept. 4, 13, 14, 25, 34, 35, 38; Bull. 38, 67, 91.

Deposits of native sulphur are known to occur in Alpine, Colusa, Imperial, Inyo, Kern, Lake, Sonoma, Tehama, and Ventura Counties. Production has been erratic, but in some recent years has amounted to nearly 10,000 tons per year, chiefly from Inyo County. The Leviathan mine, a well-known deposit in Alpine County, was acquired in 1945 by Siskon Mining Corporation, which is now proceeding with development and experimental work.

Sulphur was mined and shipped during 1946 in California from two properties in Inyo County. This was the first output since 1942.

Sulphur was produced at the famous Sulphur Bank mine in Lake County, during the years 1865-68, inclusive, following which the property became more valuable for its quicksilver. The Elgin quicksilver mine, near Wilbur Springs, Colusa County, is a similar occurrence.

Table 84. Annual tonnage and value of sulphur produced in California, 1856-1946

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2- to 5-year period (1865-67, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1865-67	941	$53,500	1932-33	1,991	$32,838	1940	8,803	$105,619
1868-1922	0	0	1934	4,412	67,656	1941	9,750	209,296
1923-24	185	4,071	1935-36	5,308	61,603	1942-46	5,478	103,901
1925-28	0	0	1937-38	9,451	120,010			
1929-31	265	9,025	1939	4,811	73,741	Totals	51,395	$841,260

TALC, SOAPSTONE, AND PYROPHYLLITE

Bibliography: State Mineralogist Rept. 12, 14, 15, 17-27 (inc.), 30, 33-39 (inc.), 41; Bull. 38, 67, 91. U. S. Bur. Mines Bull. 213.

Practically all the production of talc and steatite comes from Inyo and San Bernardino Counties. Soapstone was produced recently in minor amounts from deposits in Amador and El Dorado Counties. These minerals occur largely as the product of metamorphism.

Table 85. Production of talc, pyrophyllite, and soapstone during 1946, by county

NOTE: Where necessary in order to conceal output of individual producer in a county, production figures are combined under "Unapportioned".

County	Tons	Value
Inyo	28,076	$477,037
San Bernardino	39,623	422,739
Unapportioned (El Dorado, Mono, San Diego, Shasta)	6,447	45,518
Totals	74,146	$945,294

Pyrophyllite occurs in four localities, and some increase in production was noted in 1946. Two deposits occur in White Mountains, north of Bishop in Mono County, one near Victorville, San Bernardino County, and one near Rancho Santa Fe, San Diego County. Pyrophyllite mined from the San Diego County deposit is hauled to Chula Vista for grinding and is shipped as a dust product to the Mefford Chemical Company of Los Angeles. The absorbent quality of pyrophyllite recently has led to its widespread use as a carrier for chemicals in insecticides.

The principal production of steatite is from Inyo County. Production of talc has increased steadily since 1940, and the 1946 production was valued at $945,294, the highest on record for California. The outlook for increased production in 1947 appears to be very favorable as operators are predicting further increase in the output. The average value reported by producers in 1946 was $13.29 per ton for crude talc at mines. Ground talc is reported to sell for $20.00 to $40.00 per ton delivered to consumer.

Talc is hydrous magnesium silicate with the chemical formula $H_2Mg_3(SiO_3)_4$. It is also called soapstone and steatite. The term "talc" properly includes all forms of the pure mineral, whereas "steatite" denotes particularly the massive, compact variety, and "soapstone" the impure, massive forms containing as low as 50 percent of talc. When pure, talc is soft, having a hardness of 1, but impurities increase the hardness to 3 or 4. The color varies from pure white and silvery white through gray, green, apple green, to dark green; also yellow, brown, and reddish when impure. It is commonly compact or massive, or in fine granular aggregates, and often in foliated plates or in fibrous aggregates.

Pyrophyllite is a hydrous aluminum silicate with the chemical formula $H_2Al_2Si_4O_{12}$. Its physical properties are similar to talc and it is often impossible to tell the two minerals apart. Pyrophyllite is slightly harder than talc.

Although the uses of talc and soapstone are many and varied, some of them are not in general well known nor fully developed; and although few of the uses can justly be considered essential in the sense that no substitute can be used, several are of great importance. The widest use of talc is in the powdered form, and the value depends upon color (whiteness), uniformity, fineness of grain, freedom from grit, "slip," and sometimes freedom from lime. The white varieties, free from grit and iron, low in lime, ground to 200-mesh and finer, are largely used as a filler for paper, rubber, and paint, and the very highest grade as toilet powder. Ground talc is also used in dressing and coating cloth, in making soap, rope, twine, pipe-covering compounds, heavy lubricants, and polishes, and as a filler in concrete to make it waterproof. Ground talc and soapstone are used in ceramic body for tile and china; for foundry

facings, either alone or mixed with graphite; and a coarser grade is used in the manufacture of asphalt-coated roofing felts and papers, both as a filler and as a surfacing. Massive close-grained talc free from iron and grit is cut into blanks and baked, forming the material used for gas tips and electrical insulation, commonly known as "lava." Its hardness, its resistance to heat, acid and alkalies, and its great dielectric strength make it very useful for electrical insulation, and no satisfactory substitute for it has been found. Ceramic bodies for electric insulators are now moulded from pulverized talc.

Massive varieties of talc, pyrophyllite, and high-grade soapstone are cut into slate pencils and steel-workers' crayons. "French chalk" or "tailor's chalk" is a soft, massive talc. In China, Japan, and India, massive talc (steatite) is carved into images and other forms, and is sold as imitation jade. Soapstone is cut into slabs 1 and 2 inches in thickness and sold as griddles, footwarmers, and fireless-cooker stones; or is fabricated into laundry sinks and tubs, laboratory table tops, hoods, tanks and sinks, electric switchboards, and for other implements in which the properties of resistance to heat, acids, alkalies, and electricity are essential.

The production of talc, pyrophyllite, and soapstone in California during 1946 amounted to 74,146 net tons valued at $945,294. Shipments came from eight properties in Inyo County, four properties in San Bernardino County, and a single property each in El Dorado, Mono, San Diego, and Shasta Counties. The 1946 output showed the largest tonnage and value of any year so far in this state. In 1945 a total of 65,202 tons worth $922,682 were reported produced.

Table 86. Annual tonnage and value of talc produced in California, 1893-1946

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1893	400	$17,750	1912	1,750	$7,350	1931	13,472	$109,940
1894	0	0	1913	1,350	6,150	1932	10,690	122,880
1895	25	375	1914	1,000	4,500	1933	14,451	153,668
1896	0	0	1915	1,663	14,750	1934	13,920	158,606
1897	0	0	1916	1,703	9,831	1935	17,332	170,830
1898	0	0	1917	5,267	45,279	1936	25,643	309,287
1899	0	0	1918	11,760	85,534	1937	29,657	347,772
1900	0	0	1919	8,764	115,091	1938	28,346	290,810
1901	10	119	1920	11,327	221,362	1939	31,820	372,078
1902	14	288	1921	8,752	130,078	1940	37,433	329,425
1903	219	10,124	1922	13,378	197,186	1941	47,935	525,396
1904	228	2,315	1923	17,439	252,661	1942	47,782	545,509
1905	300	3,000	1924	16,179	242,770	1943	63,012	723,056
1906	0	0	1925	15,465	239,084	1944	64,041	824,052
1907	0	0	1926	17,004	255,645	1945	65,202	922,682
1908	3	48	1927	16,218	164,744	1946	74,146	945,294
1909	33	280	1928	18,668	251,372			
1910	740	7,260	1929	18,676	193,493	Totals	789,078	$9,483,982
1911	0	0	1930	15,861	154,258			

ZIRCON

Bibliography: State Mineralogist Rept. 34.

During 1946 no production of zircon was reported in California, but in 1941 a small shipment of zircon sand was made from the vicinity of Lincoln, Placer County, to the east coast to be used in a steel alloy. In 1937 for the first time, zircon was reported in commercial quantities in this state, from the Kaufield dragline dredge near Lincoln. Considerable zircon was recovered from the black sand, but only a small amount

was shipped, for experimental purposes in the manufacture of refractories and as an abrasive in blast sand.

The chief source of zirconium is the mineral zircon, a zirconium silicate, $ZrSiO_4$. Zircon is used as a gem, being next to the diamond in brilliancy; as a refractory, molds for steel, insulation in electric heating devices, a coating on other refractories, coating of welding rods, and in the manufacture of other zirconium compounds.

The metal zirconium is used in radio tubes and as an alloy in steel, with copper.

No prices are quoted on zircon concentrates f.o.b. California points, and most of the zircon reduction plants are on the Atlantic seaboard. The New York price, base 55 percent ZrO_2, is $60.00 to $75.00 per short ton for zircon concentrates. California prices, same base, would range from $30.00 to $45.00 per ton, depending on quantity, analysis, and other factors.

CHAPTER FOUR

SALINES

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INTRODUCTION

Bibliography: State Mineralogist Rept. 3, 14, 15, 17-29 (inc.), 33-40 (inc.). Bull. 24.

Under *Salines* are included borax, common salt, soda, potash, and other alkaline salts. The first two have been produced in a number of localities in California, more or less regularly since the early sixties. Except for 1907, soda has had a continuous production record since 1894. Potash, magnesium chloride and sulphate, and calcium chloride have been added to the commercial list in recent years, joined in 1926 by bromine, in 1931 by iodine, and in 1938 by the alum minerals.

The chief California resources of salines are the lake beds of the desert regions of Imperial, Inyo, Kern, Los Angeles, San Bernardino, and San Luis Obispo Counties, and the waters of the Pacific Ocean.

The saline group as a whole showed an increase in total value from $18,918,432 in 1945 to $21,267,532 in 1946. Borates, bromine, calcium chloride, iodine, potash, salt, and soda (soda ash and salt cake), all showed increases in amount and value during 1946 over 1945.

Magnesia registered a decline in total output. This group in 1946 showed the largest total value for any year to date.

Table 87. Comparison of 1945 and 1946 output of salines in California

Substance	1945		1946		Value of increase (+) or decrease (—)
	Tons	Value	Tons	Value	
Borates	257,299	$5,898,823	332,157	$7,230,925	$1,332,102+
Salt	734,736	2,030,226	796,761	2,274,722	244,496+
Soda (soda ash, salt cake)	311,236	3,793,571	362,015	4,476,553	682,982+
Unapportioned (bromine, calcium chlorine, iodine, magnesia and other magnesium compounds, potash)		7,195,812		7,285,332	89,520+
Total values		$18,918,432		$21,267,532	
Net increase					$2,349,100+

ALUM MINERALS

Bibliography: State Mineralogist Rept. 35, 37.

Several minerals found in California are natural alums. They are hydrous aluminum sulphates combined with sulphates of iron, potassium, sodium, or magnesium. The most important are alunite, $K_2Al_6(OH)_{12}(SO_4)_4$, a basic hydrous aluminum and potassium sulphate, and alunogen, $Al_2(SO_4)_3.16H_2O$, a hydrous aluminum sulphate.

In 1938 a small production was made and some development work was done on an alunogen deposit near Corona, Riverside County. This output was the first commercial production reported in California. An alunite deposit near Glen Ellen, Sonoma County, was opened several years ago and some development work has been done in hope of commercializing this mineral.

Table 88. Annual tonnage and value of borate materials produced in California, 1864-1946

(Tonnage figures for 1902 represent refined borax; from 1922 to date tonnage figures have been recalculated to 40 percent anhydrous boric acid equivalent.)

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1864	12	$9,478	1893	3,955	$593,292	1922	39,087	$1,068,025
1865	126	94,099	1894	5,770	807,8 7	1923	62,667	1,893,798
1866	201	132,538	1895	5,959	595,900	1924	52,070	1,599,149
1867	220	156,137	1896	6,754	675,400	1925	46,124	1,526,938
1868	32	22,384	1897	8,000	1,080,000	1926	47,605	1,625,298
1869	----------	----------	1898	8,300	1,153,000	1927	72,462	3,043,260
1870	----------	----------	1899	20,357	1,139,882	1928	109,722	3,378,552
1871	----------	----------	1900	25,837	1,013,251	1929	144,678	3,312,085
1872	140	89,600	1901	22,221	982,380	1930	209,869	3,686,817
1873	515	255,440	1902	17,202	2,234,994	1931	206,405	5,753,037
1874	915	259,427	1903	34,430	661,400	1932	179,356	2,856,470
1875	1,168	289,080	1904	45,647	698,810	1933	197,495	3,019,513
1876	1,437	312,537	1905	46,334	1,019,158	1934	240,696	5,524,262
1877	993	193,705	1906	58,173	1,182,410	1935	280,249	4,602,064
1878	373	66,257	1907	53,413	1,200,913	1936	313,389	5,911,093
1879	364	65,443	1908	22,200	1,117,000	1937	326,099	6,206,619
1880	609	149,245	1909	16,628	1,163,960	1938	276,144	5,014,237
1881	690	189,750	1910	16,828	1,177,960	1939	244,819	5,110,807
1882	732	201,300	1911	50,945	1,456,672	1940	212,358	5,254,154
1883	900	265,500	1912	42,135	1,122,713	1941	224,986	4,745,872
1884	1,019	198,705	1913	58,051	1,491,530	1942	203,716	4,929,553
1885	942	155,430	1914	62,500	1,483,500	1943	216,687	4,953,174
1886	1,285	173,475	1915	67,004	1,663,521	1944	234,860	5,264,864
1887	1,015	116,689	1916	103,523	2,409,375	1945	257,299	5,898,823
1888	1,405	196,636	1917	109,944	2,561,958	1946	332,157	7,230,925
1889	965	145,473	1918	88,772	1,867,908			
1890	3,201	480,152	1919	66,791	1,717,192	Totals	6,004,944	$147,269,074
1891	4,267	640,000	1920	127,065	2,794,206			
1892	5,525	838,787	1921	50,136	1,096,326			

BORATES[1]

Borax was first discovered in California in the waters of Tuscan Springs in Tehama County, January 8, 1856. Borax Lake in Lake County was discovered in September of the same year by Dr. John A. Veach. This deposit was worked from 1864-68, inclusive, and during that time produced 1,181,365 pounds of refined borax. The bulk of it was exported by sea to New York. This was the first commercial output of this salt in the United States, and California is still the leading American producer of borax, having been for many years the sole producer. Production from the dry lake playa deposits of Inyo and San Bernardino Counties began in 1873; but it was not until 1887 that the borax industry was revolutionized by the discovery of the colemanite beds at Calico, in San Bernardino County, and later similar beds in Inyo and Los Angeles Counties. The colemanite deposits of Ventura County were not worked extensively, owing to lack of transportation facilities. Some production of colemanite has been made from deposits opened in Clarke County, Nevada. Colemanite was in turn displaced by the discovery in 1926 of kernite (rasorite), a sodium borate, and probertite (kramerite), a hydrous sodium and calcium borate, near Kramer in Kern County.

The reserves of borate minerals in California are enormous, making this state the world's greatest source. Production of borates in California in 1947 is well up to, or above, the average for the past 8 or 9 years. Banner years of production were 1936 and 1937. After war was declared in Europe, loss of foreign markets, especially Germany, a large consumer, caused a decrease. However, in the last 4 years production has been

[1] See also Gale, H. S., Geology of the Kramer borate district, Kern County, California: California Jour. Mines and Geology, vol. 42, pp. 325-378, 1946.

normal, in spite of the many difficulties imposed by the war, and is now showing a steady increase.

Of the five producers in the state, three extract borate salts from the brines of Owens and Searles Lakes; the other two mine borate minerals from underground, where they occur interstratified in lake sediments.

The Pacific Coast Borax Company's mine at Kramer is highly mechanized, slushers and mechanical loaders are used in all working places. The American Potash & Chemical Company, the West End Chemical Corporation and the Pittsburgh Plate Glass Company, all pump brines from the lakes into their plants, where the brines are handled mechanically; hence this industry has not been affected severely by the high cost of labor.

During 1946 a total of 429,798 net tons of borate material was produced in California, as compared with 314,415 tons for 1945. This included the sodium borates kernite (rasorite) and kramerite, from Kern County; crystallized borax prepared by evaporation of brines at Searles Lake in San Bernardino County; and a small amount of colemanite from Death Valley, Inyo County.

Because the crude ore is not sold as such but is almost entirely refined into borax of commerce before shipping, and because the material varied widely in boric anhydride content, tonnage has been recalculated to a basis of 40 percent B_2O_3. This is approximately the average B_2O_3 equivalent of colemanite after calcining, and also of the crystallized borax obtained from evaporation of the lake brines. Recalculated, the 1946 output totaled 332,157 net tons, value $7,230,925, compared with 257,299 net tons, value $5,898,823, in 1945.

BROMINE

Bromine has been produced in California on a tonnage basis every year since 1926. The sources are sea bitterns, recovered after the production of common salt from sea water; and the brines of Searles Lake, which are treated primarily for potash, soda, and borax.

The principal use of bromine is for the manufacture of ethylene dibromide, which in turn is used in the manufacture of tetraethyl lead for improving gasoline by means of its knock-inhibiting property.

The bromine output in California came from two properties during 1946, one in Alameda and one in San Bernardino County.

Table 89. Tonnage and value of bromine produced in California, 1926-46

NOTE: In order to conceal output of individual producers, production figures are combined to cover 2- or 3-year periods (1926-28, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1926-28	158	$120,480	1937-38	914	$327,823	1945-46	1,606	$933,434
1929-31	802	552,933	1939-40	1,579	528,245			
1932-34	559	146,547	1941-42	2,206	741,790	Totals	11,391	$4,567,266
1935-36	805	191,465	1943-44	2,762	1,024,549			

CALCIUM CHLORIDE

Production of calcium chloride in California amounts to 10,000 tons per year. The output represents a by-product from the extraction of salt and other salines from sea water and from inland dry lakes.

California's output in recent years has come from the salt deposits on Bristol Lake near Amboy, San Bernardino County, from Salton Sea

Table 90. Tonnage and value of calcium chloride produced in California, 1921-46

NOTE: In order to conceal output of individual producers, production figures are combined to cover 2-year periods (1922-23, etc.), or omitted (1946).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1921	683	$22,980	1932-33	3,103	$15,500	1944-45	12,599	$62,400
1922-23	1,204	26,580	1934-35	4,048	16,196	1946	----------	----------
1924-25	10,988	328,876	1936-37	7,227	35,073			
1926-27	34,195	508,748	1938-39	7,279	40,182	Totals	124,616	$1,363,735
1928-29	12,020	114,080	1940-41	7,134	28,856			
1930-31	9,688	103,237	1942-43	14,448	61,027			

near Niland, and sea-water brines at Chula Vista, San Diego County. The demand for calcium chloride is limited, and therefore no increase in production is expected.

The calcium chloride produced in California during 1946 came from three properties in San Bernardino County and was the largest both in amount and value of any year so far reported.

Commercial production of calcium chloride in California was first reported to the State Mining Bureau in 1921, from two plants in San Bernardino County, being obtained as a by-product in the refining of salt from deposits in certain of the desert dry lakes.

IODINE

Bibliography: State Mineralogist Rept. 34, 36, 37. U. S. Bur. of Mines Inf. Circ. 6387.

Commercial production of iodine in California began in 1929, at which time a plant was put into operation for the extraction of this material from waste water of oil wells. In 1933 two other plants were added, and recent production has been more than 500,000 pounds per year.

At present three plants are operating, and one is under construction, all in the Los Angeles area. The Great Western Division of Dow Chemical Company is operating a plant in the Venice field and one at Seal Beach, which was moved from Long Beach in 1938. This company is now constructing a plant in the Inglewood field. The Deepwater Chemical Company operates a plant in the Dominguez field. With the addition of the new plant, production for 1947 will undoubtedly exceed that for any preceding year.

Iodine produced in California during 1945 and 1946 totaled 1,224,598 pounds valued at $1,563,069, all coming from properties of two companies in Los Angeles County.

Table 91. Poundage and value of iodine produced in California, 1929-46

NOTE: In order to conceal output of individual producers, production figures are combined to cover 2- or 3-year periods (1935-36, etc.).

Year	Pounds	Value	Year	Pounds	Value	Year	Pounds	Value
1929, 31, 33	696,297	$1,374,311	1939-40	795,510	$862,931	1945-46	1,224,598	$1,563,069
1934	355,279	423,016	1941-42	979,733	1,207,613			
1935-36	487,401	379,702	1943-44	1,194,388	1,532,700	Totals	6,357,524	$7,851,461
1937-38	624,318	508,119						

MAGNESIUM COMPOUNDS[2]

The raw products for making magnesium compounds are unlimited in California. Large deposits of magnesite still remain and there are abundant undeveloped dolomite deposits, sea water, and unlimited serpentine deposits which may some day be utilized.

Magnesium metal was produced in California in large quantities during World War II, both for castings and in powdered form for use in incendiary bombs. Two large plants that produced this metal are now shut down. Apparently new uses must be developed for this metal before its production in California will again become practicable.

On the other hand, the demand for compounds of magnesium is high. Dead-burned magnesia refractories are used in steel furnaces, and as the demand for steel is great, this use, which is the largest, continues high. Uses of the salts of magnesium include oxy-chloride cement for flooring, and other compounds for rayon manufacture and insulating materials. The hydroxide is used in pharmaceutical preparations, such as milk of magnesia. The source of raw material has shifted from magnesite mined by underground methods[3] to sea-water, or the bittern that remains after solar evaporation of sea-water for the recovery of salt. Precipitation of magnesium hydroxide has, until recently, been made with lime derived either from pure limestones or from oyster shells. At present calcined dolomite is used instead of lime as the precipitant, because the magnesia content of the dolomite is added to the output of the plant.

The principal producers of magnesium compounds in California are Westvaco Chlorine Products Corporation, Alameda County; Permanente Metals Corporation, Monterey County; and Marine Magnesium Products Corporation, San Mateo County.

Magnesium compounds produced in California during 1945 and 1946 totaled 88,381 net tons valued at $3,195,647 and came from two properties in San Mateo County and one each in Alameda, Monterey, and San Diego Counties.

Commercial production of magnesium chloride in California was begun in 1916 by some of the salt companies, from the residual bitterns obtained during the evaporation of sea water for its sodium chloride. In addition, some magnesium sulphate, or epsom salts has also been made, but in smaller amount; also magnesium carbonate, by a patented process, direct from sea water.

POTASH[4]

The American Potash & Chemical Corporation is the only producer of potash in California. Production of the company's plant at Trona, San Bernardino County, where it is extracted from the brines of Searles Lake, has been steadily increasing since 1927, when it amounted to 67,340 tons, to an annual production of approximately 190,000 tons in 1944.

More than 90 percent of the potash consumed in the United States is for agricultural use, the remainder being used in the chemical and

[2] See also Magnesium chemicals, a Chemical Engineering flowsheet: Chem. Eng., vol. 54, no. 8, pp. 132-135, 1947.

[3] For production statistics of magnesite, see Chapter 4, *Industrial Nonmetallic Minerals.*

[4] See also Bradley, W. W., Flow-sheet of American Potash and Chemical Corporation at Searles Lake, California: California Jour. Mines and Geology, vol. 41, pp. 361-363, 1945.

Table 92. Annual tonnage and value of magnesium salts produced in California, 1916-46

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1927-28, etc.).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1916	851	$6,407	1926	4,881	$124,470	1939	3,895	$382,457
1917	1,064	34,973	1927-28	6,241	139,589	1940	4,325	419,666
1918	1,008	29,955	1929-30	4,914	333,906	1941	6,352	654,372
1919	1,616	82,457	1931-32	2,749	217,979	1942	6,260	642,680
1920	3,150	107,787	1933	2,073	159,660	1943	9,026	728,065
1921	4,153	106,140	1934	2,325	194,642	1944	113,927	4,537,381
1922	3,036	89,788	1935	2,785	235,531	1945-46	88,381	3,195,647
1923	3,662	116,031	1936	3,798	347,838			
1924	4,823	145,883	1937	3,867	316,669	Totals	317,559	$13,952,112
1925	4,221	132,553	1938	24,176	469,636			

Table 93. Annual tonnage and value of potash produced in California, 1914-46

NOTE: Where necessary in order to conceal output of individual producers, production figures are combined to cover a 2-year period (1928-29, etc.), or omitted (1946).

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1914	10	$460	1923	29,597	$709,836	1936-37	358,417	$6,988,922
1915	1,076	19,391	1924	33,107	747,407	1938-39	383,981	9,057,866
1916	17,808	663,605	1925	36,355	829,770	1940-41	310,023	6,058,274
1917	129,022	4,202,889	1926	32,884	812,285	1942-43	375,542	7,647,355
1918	49,381	6,808,976	1927	67,340	1,952,852	1944-45	392,213	8,345,318
1919	28,118	2,415,963	1928-29	178,680	5,522,350	1946		
1920	26,298	1,465,463	1930-31	172,263	5,500,536			
1921	14,806	390,210	1932-33	153,147	3,932,721	Totals	3,163,448	$78,407,646
1922	17,776	584,388	1934-35	355,604	3,750,809			

Table 94. Annual tonnage and value of salt produced in California, 1887-1946

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1887	28,000	$112,000	1908	121,764	$281,469	1929	392,039	$2,665,436
1888	30,800	92,400	1909	155,680	414,708	1930	347,945	1,167,487
1889	21,000	63,000	1910	174,920	395,417	1931	330,951	1,233,567
1890	8,729	57,085	1911	173,332	324,255	1932	256,353	918,480
1891	20,094	90,303	1912	185,721	383,370	1933	321,312	1,251,024
1892	23,570	104,788	1913	204,407	462,681	1934	332,194	1,222,810
1893	50,500	213,000	1914	223,806	583,553	1935	365,711	1,230,480
1894	49,131	140,087	1915	169,028	368,737	1936	398,249	1,227,505
1895	53,031	150,576	1916	186,148	455,695	1937	370,431	1,044,325
1896	64,743	153,244	1917	227,825	584,373	1938	395,746	1,099,737
1897	67,851	157,520	1918	212,076	806,328	1939	417,956	1,174,386
1898	93,421	170,855	1919	233,994	896,963	1940	462,282	1,290,728
1899	82,654	149,588	1920	230,638	972,648	1941	434,237	1,180,929
1900	89,338	204,754	1921	197,989	832,702	1942	672,324	1,922,991
1901	126,218	366,376	1922	223,238	819,187	1943	631,776	1,695,231
1902	115,208	205,876	1923	275,979	1,130,670	1944	769,873	2,060,960
1903	102,895	211,365	1924	318,800	1,159,137	1945	734,736	2,030,226
1904	95,968	187,300	1925	284,068	949,826	1946	796,761	2,274,722
1905	77,118	141,925	1926	311,761	1,124,978			
1906	101,650	213,228	1927	263,028	639,127	Totals	14,535,640	$44,797,741
1907	88,063	310,967	1928	340,580	1,024,656			

industrial fields. Demand for potash for agricultural purposes should increase in 1947.

The 1946 production of potash in California, which came from a single operator, was principally chloride and some sulphate, the product averaging 60 percent equivalent K_2O content. The material was sold mainly for fertilizer manufacture. The 1946 output showed an increase in amount and value over that of 1945.

Potash production began commercially in California in 1914, with a small yield from kelp.

SALT

Bibliography: State Mineralogist Rept. 2, 12-15 (inc.), 17-23 (inc.), 25-27 (inc.), 34-40 (inc.) ; Bull. 24, 67, 91. U. S. Geol. Survey Bull. 669. U. S. Bur. Mines Bull. 146.

Plants producing salt from sea water are operated on San Francisco, Monterey, Newport, and San Diego bays, and at Long Beach. Inland regions producing salt are in Imperial, Kern, and San Bernardino Counties.

The production of salt is a thriving industry in California, amounting to considerably more than $2,000,000 per year. Production has more than doubled in the past 10 years; in 1937 it was only slightly over $1,000,000. Most of the salt is derived from the evaporation of sea water, but some comes from desert lakes and some is mined from deposits of rock salt.

Besides the common use of salt on the dinner table and for feeding stock, this saline mineral has many uses, most important of which is in making soda ash. Salt is the original raw material for nearly all chemical compounds of sodium and chlorine; one manufacturer has listed 1400 uses. Most of the soda ash produced in the world is derived from salt, but in California natural sources of soda ash are available.

The salt produced during 1946 in California totaled 796,761 net tons valued at $2,274,722, compared with 734,736 tons worth $2,030,226 in 1945. The 1946 salt output was the largest yield for any year so far reported and came from three properties in Alameda County; two in San Bernardino County; and one each in Imperial, Kern, Mono, Monterey, Orange, and San Diego Counties. The average value reported by salt producers in California in 1946 was $2.85 per ton f.o.b. plant, compared with $2.76 per ton in 1945, $2.68 per ton in 1944 and 1943, $2.90 per ton in 1942, and $2.72 in 1941.

Although salt has been produced in California since the early sixties, there are no definite or authenticated records for the years prior to 1887.

SODA

Bibliography: State Mineralogist Rept. 12, 13, 15, 17, 18, 20, 22, 23, 25-29 (inc.), 36-39 (inc.) ; Bull. 24, 67, 91. U. S. Geol. Survey Bull. 717.

Soda ash is one of the most important of the alkalies and is produced in greater quantity than other heavy chemicals except sulfuric acid and common salt. The source of California's soda ash is, at present, natural brines. Soda ash may be produced from common salt by various methods involving large capital investment in plant, and from natural deposits of the carbonates of sodium found in saline lakes and in bedded deposits. In the United States, about 90 percent of the soda ash marketed is produced from common salt, principally in the eastern and midwestern states.

A recent survey indicates that the United States demand for soda ash will exceed the supply by an appreciable margin, at least for several years, without allowance for exports, for which great pressure exists, because of the general world shortage of soda ash. This condition is accentuated in California because of the rapid growth of industry and population. Of the total demand for soda ash, the glass, soap, and cleanser industries require about 37 percent, the chemical industry about 49 percent, the pulp and paper, aluminum, textile, and petroleum industries combined about 11 percent, and miscellaneous industries about

Table 95. Annual tonnage and value of soda produced in California, 1894-1946

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1894	1,530	$20,000	1913	1,861	$24,936	1932	58,017	$826,369
1895	1,900	47,500	1914	6,522	115,396	1933	70,598	1,019,130
1896	3,000	65,000	1915	5,799	83,485	1934	99,380	1,219,561
1897	5,000	110,000	1916	10,593	264,825	1935	125,504	1,341,045
1898	7,000	154,000	1917	24,505	928,578	1936	144,314	1,412,788
1899	10,000	250,000	1918	20,447	855,423	1937	153,685	1,461,057
1900	1,000	50,000	1919	21,294	721,958	1938	178,105	2,023,610
1901	8,000	400,000	1920	32,407	1,164,898	1939	200,049	2,055,608
1902	7,000	50,000	1921	14,828	438,996	1940	228,108	2,339,639
1903	18,000	27,000	1922	20,084	573,661	1941	179,210	2,028,718
1904	12,000	18,000	1923	34,885	764,284	1942	267,723	3,125,078
1905	15,000	22,500	1924	32,536	711,796	1943	260,590	3,166,576
1906	12,000	18,000	1925	48,625	947,649	1944	299,574	3,647,630
1907	0	0	1926	63,333	1,305,802	1945	311,236	3,793,571
1908	9,600	14,400	1927	62,571	1,478,239	1946	362,015	4,476,553
1909	7,712	11,593	1928	80,838	1,469,297			
1910	8,125	11,862	1929	90,646	1,838,657	Totals	3,821,795	$51,829,804
1911	9,023	52,887	1930	90,122	1,627,344			
1912	7,200	37,094	1931	78,701	1,217,811			

3 percent. The California glass, soap, and chemical industries, now being expanded, are all in the category of heavy users of soda ash, and the demand for this chemical will increase in California at a greater rate than in the United States as a whole. This will entail further expansion of existing plants extracting soda ash from California brines and lake beds, development of potential natural reserves such as the brine of Mono Lake and saline lakes in the southern part of the state, and possibly the installation of one or more Solvay process plants on the Pacific Coast for the conversion of salt to soda ash. As this type of plant requires a very large capital investment ($30,000 per ton capacity per 24 hours) and is economical only in large units (500 to 1000 tons per day), probably intensive development of California reserves of natural soda ash will take place in the order of their potential economic value before the building of plants for the conversion of salt. The future production of the Green River, Wyoming, deposits will doubtless supply part of the California demand, but the pressure of midwestern and eastern demand, as well as Washington and Oregon potential demand and exports, will probably absorb a very appreciable part of the Green River production.

The sodium salts produced in California during 1946 included soda ash and trona from two plants on Owens Lake, Inyo County, and two plants on Searles Lake, San Bernardino County; salt cake from one property on Searles Lake and one on Dale Lake near Amboy, both in San Bernardino County. Shipments during 1946 amounted to a total of 362,-015 net tons valued at $4,476,553, compared with 311,236 tons worth $3,793,571 in 1945. The 1946 soda output was the largest of any year so far reported in this state both in amount and value. It consisted of 201,271 tons of soda ash and trona, and 160,744 tons of salt cake. During the year no shipments of salt cake were reported from Durmid Hills, Imperial County, or Carrizo Plains, San Luis Obispo County.

The soda ash was used mainly in the manufacture of soap, glass, paper, oil refining, sugar refining, chemicals, and water softener; and the trona for metallurgical purposes, as in the refining of copper, tungsten, and aluminum; in chemicals and water purification. The salt cake or sodium sulphate was used in the manufacture of paper, glass, and in chemicals.

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LIST OF COUNTIES IN CALIFORNIA, SHOWING AMOUNT AND VALUE OF THE MINERAL SUBSTANCES PRODUCED IN EACH DURING 1946

The State of California includes an area of 158,297 square miles, of which 156,803 square miles are land (according to 1940 census resurvey). The maximum width is 235 miles, the minimum 148 miles, and the length from the northwest corner to the southeast corner is 775 miles. The state is divided into 58 counties. The 1940 census figures show a population of 6,907,387 in California; late in 1947 this figure had increased to nearly 10,000,000. Minerals of commercial value exist in every county, and during 1946 some active production was reported to the State Division of Mines from each of the 58.

Of the 10 leading counties in point of total values of mineral output during 1946, the first five, Kern, Los Angeles, Fresno, Orange, and Ventura; and Santa Barbara, seventh, and Kings, eighth, owe their position to petroleum and natural gas; Sacramento, ninth, to natural gas, gold and miscellaneous stone. Kern County, which led all other counties in 1946 and is credited with 27 percent of the state's value of mineral production, passed Los Angeles County in 1944. Both counties owe their position to crude oil. San Bernardino County, sixth, owes its position to cement, borates, potash, and soda; and Santa Clara, tenth, to cement.

Twenty-seven counties had a mineral production with a value in excess of a million dollars in 1946. The value of natural gas exceeded a million dollars in nine counties; cement in eight counties; petroleum in seven counties; miscellaneous stone in five counties; gold in three counties; borates and brick in two counties each; and lead, diatomite, potash, salt, soda, and tungsten ore in one county each.

In variety and diversity of products San Bernardino County led all others in 1946 with 30 different mineral substances on its commercial list. It was followed by Inyo and Kern Counties with 16 each; Los Angeles County with 14; Riverside County with 13; Fresno, Orange, San Diego, and Shasta Counties with 12 each; and Butte and Calaveras Counties with 10 each.

Alameda

Substance	Amount	Value
Clay (pottery)	9,566 tons	$16,166
Stone, miscellaneous	----	3,120,783
Unapportioned (brick, hollow tile, bromine, magnesia, salt)	----	1,723,365
Total value		$4,860,314

Alpine

The only 1946 production in Alpine County was miscellaneous stone.

Amador

Substance	Amount	Value
Clay (pottery)	90,416 tons	$194,061
Copper	2,041,536 lbs.	330,729
Gold	2,638 fine ozs.	92,330
Silver	15,626 fine ozs.	12,626
Stone, miscellaneous	----	3,963
Unapportioned (brick, lead)	----	118,755
Total value		$752,464

Table 96. Comparison of 1945 and 1946 mineral production by counties.

County	Number of substances produced		Rank by value of mineral prod.		Total value of mineral production		References (Report of State Mineralogist)
	1945	1946	1945	1946	1945	1946	
Alameda	9	7	10	15	$6,661,939	$4,860,314	R25, pp. 427-456
Alpine	1	1	58	58	1,500	1,000	R27, pp. 488-491
Amador	8	7	33	32	487,544	752,464	R23, pp. 131-202
Butte	8	10	29	28	663,610	974,171	R26, pp. 360-412
Calaveras	9	10	16	16	2,789,881	3,432,594	R32, pp. 226-235
Colusa	1	1	57	51	7,083	93,784	R25, pp. 284-300
Contra Costa	9	9	17	17	2,496,533	3,266,972	R23, pp. 2- 31
Del Norte	4	6	38	52	341,306	91,919	R29, pp. 123-160
El Dorado	10	9	39	31	301,627	838,234	R34, pp. 206-280
Fresno	12	12	3	3	51,677,246	59,194,945	R25, pp. 301-336
Glenn	2	2	52	50	72,046	141,508	R25, pp. 418-426
Humboldt	7	7	43	45	201,514	293,859	R37, pp. 429-528
Imperial	8	9	37	33	383,431	726,044	R38, pp. 105-145
Inyo	15	16	14	13	4,258,250	6,218,539	R34, pp. 368-590
Kern	18	16	1	1	126,716,070	133,082,652	R25, pp. 20- 81
Kings	3	3	8	8	13,568,174	15,604,139	R26, pp. 413-423
Lake	3	4	44	49	197,448	161,844	R25, pp. 337-365
Lassen	2	2	56	48	20,635	177,090	R32, pp. 405-443
Los Angeles	12	14	2	2	103,641,827	124,946,810	R33, pp. 173-213
Madera	7	6	46	41	189,886	391,363	R30, pp. 7- 78
Marin	5	4	32	29	491,435	871,162	R22, pp. 314-365
Mariposa	7	8	25	36	1,171,094	613,477	R24, pp. 72-153
Mendocino	3	3	48	42	118,767	383,431	R25, pp. 456-467
Merced	4	4	40	43	285,363	321,158	R21, pp. 173-183
Modoc	4	3	45	54	193,156	75,418	R32, pp. 445-457
Mono	10	7	49	53	91,928	84,868	R36, pp. 117-156
Monterey	8	8	15	22	3,018,280	2,044,023	R21, pp. 25- 57
Napa	7	6	30	27	628,974	1,018,955	R25, pp. 213-242
Nevada	5	6	23	23	1,196,433	1,987,650	R26, pp. 90-137
Orange	11	12	4	4	35,178,471	41,404,311	R21, pp. 59- 71
Placer	10	9	42	46	241,359	228,968	R32, pp. 7- 96
Plumas	6	6	55	47	41,243	192,176	R33, pp. 79-146
Riverside	12	13	13	11	4,644,406	6,320,268	R41, pp. 121-182
Sacramento	9	8	9	9	9,240,880	13,821,490	R21, pp. 2- 22
San Benito	4	4	21	25	1,949,386	1,572,291	R22, pp. 217-247
San Bernardino	29	30	6	6	23,038,011	30,515,887	R39, pp. 427-549
San Diego	11	12	26	24	1,142,350	1,729,393	R21, pp. 327-383
San Francisco	2	4	51	57	75,172	38,172	R25, pp. 242-245
San Joaquin	8	8	22	21	1,256,594	2,230,561	R21, pp. 184-200
San Luis Obispo	7	7	31	44	497,923	229,274	R31, pp. 402-464
San Mateo	5	5	18	14	2,363,508	5,917,877	R25, pp. 245-259
Santa Barbara	5	9	7	7	22,643,580	28,102,174	R21, pp. 539-562
Santa Clara	10	9	11	10	5,810,388	8,568,863	R26, pp. 3- 39
Santa Cruz	8	4	20	19	2,015,407	2,363,898	R39, pp. 11- 52
Shasta	12	12	19	18	2,119,802	2,420,213	R35, pp. 108-189
Sierra	3	3	47	39	172,782	402,174	R38, pp. 7- 67
Siskiyou	10	7	27	35	926,305	653,147	R31, pp. 255-338
Solano	2	2	12	12	5,282,725	6,254,628	R23, pp. 203-313
Sonoma	4	5	28	30	807,122	859,077	R22, pp. 337-365
Stanislaus	6	6	36	26	406,727	1,103,654	R21, pp. 200-222
Sutter	2	2	54	55	62,910	73,248	No county report
Tehama	3	2	53	56	69,921	64,850	R42, pp. 183-195
Trinity	7	8	50	37	91,560	514,883	R37, pp. 8- 89
Tulare	3	4	41	34	256,764	669,333	R26, pp. 423-471
Tuolumne	8	7	35	40	434,626	399,967	R24, pp. 3- 53
Ventura	8	7	5	5	29,352,740	37,333,004	R28, pp. 247-276
Yolo	4	4	34	38	479,810	487,812	R17, pp. 260-261
Yuba	5	5	24	20	1,186,139	2,273,106	R26, pp. 186-201

Butte

Substance	Amount	Value
Copper	24,202 lbs.	$3,921
Gold	21,953 fine ozs.	768,355
Silver	1,623 fine ozs.	1,311
Stone, miscellaneous	----	147,534
Zinc	67,073 lbs.	8,183
Unapportioned (lead, mineral water, natural gas, platinum)	----	17,867
Total value		$947,171

Calaveras

Substance	Amount	Value
Copper	1,859,691 lbs.	$301,270
Gold	6,602 fine ozs.	231,070
Lead	320,178 lbs.	34,900
Silver	111,370 fine ozs.	89,987
Stone, miscellaneous	----	23,621
Zinc	6,601,266 lbs.	805,354
Unapportioned (cement, pottery clay, mineral water, pumice)	----	1,946,392
Total value		$3,432,594

Colusa

The only commercial production in Colusa County for 1946 consisted of miscellaneous stone.

Contra Costa

Substance	Amount	Value
Stone, miscellaneous	----	$669,497
Unapportioned (brick, hollow tile, cement, mineral water, natural gas, pumice, quicksilver, silica [glass sand])	----	2,597,475
Total value		$3,266,972

Del Norte

Substance	Amount	Value
Gold	24 fine ozs.	$840
Silver	21 fine ozs.	17
Stone, miscellaneous	----	66,565
Unapportioned (chromite, copper, quicksilver)	----	24,497
Total value		$91,919

El Dorado

Substance	Amount	Value
Gold	2,723 fine ozs.	$95,305
Limestone	248,402 tons	578,136
Silver	1,318 fine ozs.	1,065
Stone, miscellaneous	----	101,170
Unapportioned (copper, lead, slate, soapstone)	----	62,558
Total value		$838,234

Fresno

Substance	Amount	Value
Gold	272 fine ozs.	$9,520
Natural gas	55,454,786 M cu. ft.	4,806,207
Petroleum	42,645,954 bbls.	53,357,732
Silver	42 fine ozs.	34
Stone, miscellaneous	----	677,404
Unapportioned (brick, hollow tile, granite, gypsum, limestone, quicksilver, tungsten ore)	----	354,048
Total value		$59,204,945

Glenn

Substance	Amount	Value
Stone, miscellaneous	----	$57,390
Other minerals	----	84,118
Total value		$141,508

Humboldt

Substance	Amount	Value
Gold	64 fine ozs.	$2,240
Silver	8 fine ozs.	6
Stone, miscellaneous	----	245,087
Unapportioned (brick, pottery clay, natural gas)	----	46,526
Total value		$293,859

Imperial

Substance	Amount	Value
Gold	203 fine ozs.	$7,105
Silver	62 fine ozs.	50
Stone, miscellaneous	----	136,300
Unapportioned (carbon dioxide, gypsum, kyanite, mica, salt, strontium)	----	582,589
Total value		$726,044

Inyo

Substance	Amount	Value
Copper	446,386 lbs.	$72,315
Gold	3,096 fine ozs.	108,360
Lead	19,124,830 lbs.	2,084,606
Pumice	8,496 tons	73,173
Silver	970,167 fine ozs.	783,895
Stone, miscellaneous	----	18,312
Talc	28,076 tons	477,037
Zinc	2,279,963 lbs.	278,155
Unapportioned (bentonite, borates, dolomite, limestone, molybdenum ore, soda, sulfur, tungsten ore)	----	2,322,686
Total value		$6,218,539

Kern

Substance	Amount	Value
Clay (pottery and oil well drilling)	177,960 tons	$544,841
Gold	2,706 fine ozs.	94,710
Gypsum	268,162 tons	352,484
Natural gas	72,945,848 M cu. ft.	5,694,426
Petroleum	100,640,406 bbls.	120,353,402
Silver	8,629 fine ozs.	6,972
Stone, miscellaneous	----	327,259
Unapportioned (bentonite, borates, brick, cement, pumice, volcanic ash, salt, tungsten ore)	----	5,708,558
Total value		$133,082,652

Kings

Substance	Amount	Value
Natural gas	41,778,881 M cu. ft.	$3,618,803
Petroleum	8,265,449 bbls.	11,984,901
Other minerals	----	435
Total value		$15,604,139

Lake

Substance	Amount	Value
Mineral water	6,369 gals.	$1,957
Stone, miscellaneous	----	100,893
Other minerals	----	58,994
Total value		$161,844

Lassen

Substance	Amount	Value
Stone, miscellaneous	----	$175,690
Other minerals	----	1,400
Total value		$177,090

Los Angeles

Substance	Amount	Value
Brick and hollow building tile	86,661 M	$2,564,659
Clay (pottery)	78,182 tons	179,247
Gold	36 fine ozs.	1,260
Mineral water	15,981,331 gals.	572,397
Natural gas	89,543,147 M cu. ft.	7,718,409
Petroleum	87,150,496 bbls.	106,266,566
Silver	5 fine ozs.	4
Stone, miscellaneous	----	6,100,968
Unapportioned (diatomite, iodine, iron ore, sandstone, titanium minerals)	----	1,543,300
Total value		$124,946,810

Madera

Substance	Amount	Value
Gold	55 fine ozs.	$1,925
Pumice and volcanic ash	33,052 tons	186,233
Silver	19 fine ozs.	15
Unapportioned (feldspar, natural gas, miscellaneous stone)	----	203,190
Total value		$391,363

Marin

Commercial production in Marin County consisted of clay (pottery), mineral water, crushed rock, sand, and gravel.

Mariposa

Substance	Amount	Value
Gold	3,490 fine ozs.	$122,150
Silver	1,111 fine ozs.	898
Zinc	571,137 lbs.	69,679
Unapportioned (barite, copper, lead, silica, miscellaneous stone)	----	420,750
Total value		$613,477

Mendocino

Substance	Amount	Value
Stone, miscellaneous	----	$306,973
Other minerals	----	76,458
Total value		$383,431

Merced

Substance	Amount	Value
Gold	3,732 fine ozs.	$130,620
Silver	341 fine ozs.	276
Stone, miscellaneous	----	189,935
Other minerals	----	327
Total value		$321,158

Modoc

Substance	Amount	Value
Pumice	1,945 tons	$12,075
Stone, miscellaneous	----	63,263
Other minerals	----	80
Total value		$75,418

Mono

Substance	Amount	Value
Gold	926 fine ozs.	$32,410
Silver	984 fine ozs.	795
Stone, miscellaneous	----	6,078
Unapportioned (pumice, salt, pyrophyllite, tungsten ore)	----	45,585
Total value		$84,868

Monterey

Substance	Amount	Value
Stone, miscellaneous	----	$225,775
Unapportioned (dolomite, gypsum, magnesia, salt, sandstone, silica [glass sand])	----	1,818,648
Total value		$2,044,423

Napa

Commercial production in Napa County for 1946 included mineral water, pumice, quicksilver, sandstone, and miscellaneous stone.

Nevada

Substance	Amount	Value
Gold	55,168 fine ozs.	$1,930,880
Silver	12,698 fine ozs.	10,260
Stone, miscellaneous	----	46,500
Other minerals	----	10
Total value		$1,987,650

Orange

Substance	Amount	Value
Gold	14 fine ozs.	$490
Natural gas	27,489,820 M cu. ft.	2,305,823
Petroleum	31,859,905 bbls.	38,428,250
Silver	2,785 fine ozs.	2,250
Stone, miscellaneous	----	607,060
Zinc	28,311 lbs.	3,454
Unapportioned (copper, lead, mineral water, pottery clay, salt)	----	56,984
Total value		$41,404,311

Placer

Substance	Amount	Value
Gold	3,116 fine ozs.	$109,060
Silver	341 fine ozs.	276
Stone, miscellaneous	----	36,343
Unapportioned (asbestos, brick, pottery clay, granite, slate)	----	83,289
Total value		$228,968

Plumas

Substance	Amount	Value
Gold	351 fine ozs.	$12,285
Silver	71 fine ozs.	57
Stone, miscellaneous	----	176,999
Other minerals	----	2,835
Total value		$192,176

Riverside

Substance	Amount	Value
Clay (pottery)	113,785 tons	$280,103
Gold	3 fine ozs.	105
Silver	92 fine ozs.	74
Stone, miscellaneous	----	441,638
Unapportioned (brick, cement, copper, granite, gypsum, iron ore, mineral water, silica [glass sand])	----	5,598,348
Total value		$6,320,268

Sacramento

Substance	Amount	Value
Gold	100,275 fine ozs.	$3,509,625
Natural gas	81,027,875 M cu. ft.	8,639,377
Silver	5,354 fine ozs.	4,326
Stone, miscellaneous	----	1,371,660
Unapportioned (brick, hollow tile, pottery clay, platinum)	----	296,502
Total value		$13,821,490

San Benito

Commercial output in San Benito County for 1946 consisted of dolomite, mineral water, quicksilver, and miscellaneous stone.

San Bernardino

Substance	Amount	Value
Clay (pottery)	16,577 tons	$104,855
Copper	83,366 lbs.	13,505
Gold	4,901 fine ozs.	171,535
Lead	947,067 lbs.	103,230
Limestone	300,833 tons	556,864
Silver	97,411 fine ozs.	78,708
Stone, miscellaneous	----	1,005,311
Talc	39,623 tons	422,739
Zinc	1,240,776 lbs.	151,375
Unapportioned (bentonite, borates, brick, bromine, calcium chloride, cement, gems, granite, iron ore, lithia, marble and onyx, mineral paint, mineral water, potash, salt, silica [quartz], soda ash, salt cake, strontium, tungsten ore)	----	27,907,765
Total value		$30,515,887

San Diego

Substance	Amount	Value
Gold	2 fine ozs.	$70
Stone, miscellaneous	----	1,127,807
Unapportioned (brick, granite, limestone, magnesium salts, mineral water, salt, silica [glass sand], pyrophyllite, grinding-mill pebbles)	----	601,516
Total value		$1,729,393

San Francisco

Production in San Francisco County consists mainly of crushed rock, sand, gravel, mineral water, and gold and silver from beach sands.

San Joaquin

Substance	Amount	Value
Gold	13,715 fine ozs.	$480,025
Natural gas	9,524,708 M cu. ft.	987,399
Silver	1,361 fine ozs.	1,100
Stone, miscellaneous	----	705,433
Unapportioned (brick, hollow tile, pottery clay, platinum)	----	56,604
Total value		$2,230,561

San Luis Obispo

Commercial production in San Luis Obispo County for 1946 consisted of brick, gems (agate), limestone (flagstone), mineral water, petroleum, quicksilver, and miscellaneous stone.

San Mateo

Substance	Amount	Value
Stone, miscellaneous	----	$2,965,755
Unapportioned (cement, limestone [shell], magnesia)	----	2,952,122
Total value		$5,917,877

Santa Barbara

Substance	Amount	Value
Natural gas	13,438,669 M cu. ft.	$1,279,358
Petroleum	22,112,577 bbls.	23,958,353
Stone, miscellaneous	----	37,469
Unapportioned (brick, pottery clay, diatomite, mineral water, quicksilver, sandstone)	----	2,826,994
Total value		$28,102,174

Santa Clara

Substance	Amount	Value
Stone, miscellaneous	----	$776,625
Unapportioned (brick, cement, pottery clay, limestone [part shells], petroleum, quicksilver, serpentine)	----	7,792,238
Total value		$8,568,863

Santa Cruz

Substance	Amount	Value
Stone, miscellaneous	----	$383,953
Unapportioned (bituminous rock, cement, limestone)	----	1,979,945
Total value		$2,363,898

Shasta

Substance	Amount	Value
Copper	3,912,947 lbs.	$633,897
Gold	12,825 fine ozs.	448,875
Lead	27,110 lbs.	2,955
Silver	100,143 fine ozs.	80,916
Stone, miscellaneous	----	298,852
Zinc	3,851,278 lbs.	469,856
Unapportioned (asbestos, iron ore, mineral water, pyrite, talc)	----	484,862
Total value		$2,420,213

Sierra

Substance	Amount	Value
Gold	11,427 fine ozs.	$399,945
Silver	2,140 fine ozs.	1,729
Other minerals	----	1,500
Total value		$403,174

Siskiyou

Substance	Amount	Value
Gold	8,706 fine ozs.	$304,710
Pumice	5,771 tons	42,600
Silver	1,208 fine ozs.	976
Stone, miscellaneous	----	275,120
Unapportioned (mineral water, platinum)	----	29,741
Total value		$653,147

Solano

Substance	Amount	Value
Natural gas	61,468,903 M cu. ft.	$6,228,130
Other minerals	----	26,498
Total value		$6,254,628

Sonoma

Substance	Amount	Value
Stone, miscellaneous	----	$559,922
Unapportioned (tuff, mineral water, quicksilver)	----	299,155
Total value		$859,077

Stanislaus

Substance	Amount	Value
Gold	24,158 fine ozs.	$845,530
Silver	1,824 fine ozs.	1,474
Stone, miscellaneous	----	219,863
Unapportioned (natural gas, platinum, pottery clay)	----	36,787
Total value		$1,103,654

Sutter

Sutter is one of only two counties in the state which for a number of years reported no commercial output of any kind of mineral substance. In 1917 some crushed rock was taken out, from the Marysville Buttes, also in 1925-28, and 1937-38. Some utilization of natural gas and clay has been made. Coal is found here, but no deposits of it have been placed on a productive basis. During 1946 a commercial output of pottery clay and natural gas was reported.

Tehama

Commercial production in Tehama County in 1946 consisted of mineral water and miscellaneous stone.

Trinity

Substance	Amount	Value
Gold	13,962 fine ozs.	$488,670
Silver	1,428 fine ozs.	1,154
Stone, miscellaneous	----	22,715
Unapportioned (coal, copper, platinum, quicksilver)	----	2,344
Total value		$514,883

Tulare

Substance	Amount	Value
Stone, miscellaneous	----	$207,396
Tungsten ore	----	117,696
Other minerals	----	344,241
Total value		$669,333

Tuolumne

Substance	Amount	Value
Gold	1,662 fine ozs.	$58,170
Silver	1,095 fine ozs.	885
Stone, miscellaneous	----	78,471
Unapportioned (copper, dolomite, limestone)	----	262,441
Total value		$399,967

Ventura

Substance	Amount	Value
Natural gas	49,579,660 M cu. ft.	$4,250,873
Petroleum	24,391,381 bbls.	32,416,978
Stone, miscellaneous	----	406,405
Unapportioned (oil-well drilling clay, gypsum, limestone [marl])	----	258,748
Total value		$37,333,004

Yolo

Substance	Amount	Value
Stone, miscellaneous	----	$203,936
Unapportioned (natural gas, quicksilver)	----	283,876
Total value		$487,812

Yuba

Substance	Amount	Value
Gold	57,991 fine ozs.	$2,029,685
Silver	3,371 fine ozs.	2,724
Stone, miscellaneous	----	238,182
Other minerals	----	2,515
Total value		$2,273,106

9—82576

DIRECTORY OF PRODUCERS OF METALLIC AND NONMETALLIC MINERALS IN CALIFORNIA IN 1946[1]

ASBESTOS (TREMOLITE)

Operator	Address	Location of mine
Placer County		
Joe Delmue & W. Zindars	Forest Hill	Forest Hill
Shasta County		
Powhatan Mining Co.	Woodlawn, Baltimore, Md.	Sims
Sylvester, Ray	Box 1435, Weed	Weed

BARITE

Operator	Address	Location of mine
Mariposa County		
Baroid Sales Division, National Lead Co.	830 Ducommun St., Los Angeles	El Porta
Plumas County		
Barium Products Ltd.	Newark	Almanor

BENTONITE (FULLERS EARTH)

Operator	Address	Location of pit
Inyo County		
Sierra Talc Company	5509 Randolph, Los Angeles	Olancha
Kern County		
D. P. Covert	309 Bank of America Bldg., Glendale	Boron
San Bernardino County		
Baroid Sales Division, National Lead Co.	830 Ducommun St., Los Angeles	Hector
Pacific Bentonite Mine, Louis Martinez	Box 374, Red Mountain	Red Mountain

[1] Producers of natural gas and petroleum may be found in the Summary of Operations, California Oil Fields, July-Dec. 1946, vol. 32, no. 2, of the State Division of Oil and Gas.

BITUMINOUS ROCK

Operator	Address	Location of mine
Santa Cruz County		
Calrock Asphalt Co.	232 Montgomery St., San Francisco	Majors

BORATES

Operator	Address	Location of property
Inyo County		
United States Borax Co.	510 W. 6th St., Los Angeles	Death Valley
Kern County		
Pacific Coast Borax Co.	510 W. 6th St., Los Angeles	Kramer
San Bernardino County		
American Potash and Chemical Corp.	Trona	Trona
West End Chemical Co.	Latham Square Bldg., Oakland	West End

BROMINE

Operator	Address	Location of property
Alameda County		
Westvaco Chlorine Prod. Corp.	405 Lexington Ave., New York, N. Y.	Newark
San Bernardino County		
American Potash and Chemical Co.	Trona	Trona

CALCIUM CHLORIDE

Operator	Address	Location of mine
San Bernardino County		
California Rock Salt Co.	2465 Hunter St., Los Angeles	Amboy
Hill Brothers Chemical Co.	2159 Bay St., Los Angeles 21	Amboy
National Chlorides Co.	Amboy	Amboy

CARBON DIOXIDE GAS

Operator	Address	Location of wells
Imperial County		
Cardox Western, Inc.	748 Washington Blvd., Los Angeles 21	Niland
Mendocino County		
Caldri Ice Corp.	1168 Battery St., San Francisco	Hopland

CEMENT

Operator	Address	Location of mill
Calaveras County		
Calaveras Cement Co.	315 Montgomery St., San Francisco 4	San Andreas
Contra Costa County		
Henry Cowell Lime and Cement Co.	2 Market St., San Francisco 11	Cowell
Kern County		
Monolith Portland Cement Co.	Bartlett Bldg., Los Angeles	Monolith
Los Angeles County		
Blue Diamond Corp.	1650 S. Alameda St., Los Angeles	Los Angeles
Riverside County		
Riverside Cement Co.	621 S. Hope St., Los Angeles	Riverside
San Bernardino County		
California Portland Cement Co.	601 W. Fifth St., Los Angeles	Colton
Riverside Cement Co.	621 South Hope St., Los Angeles	Oro Grande
Southwestern Portland Cement Co.	503 Roosevelt Bldg., Los Angeles	Victorville
San Mateo County		
Pacific Portland Cement Co.	417 Montgomery St., San Francisco 1	Redwood City
Santa Clara County		
Permanente Cement Co.	Permanente	Permanente
Santa Cruz County		
Santa Cruz Portland Cement Co.	Crocker Bldg., San Francisco	Davenport

CHROMITE

Producers in 1946

Mine	Operator	Address	Location of mine
Del Norte County			
Tyson (French Hill)	Sam J. Wilson	Crescent City	Crescent City
4th of July*	C. H. McClendon	Crescent City	Crescent City
Shasta County			
*	Antone Orsini	1409 Olive St., Redding	

* None shipped.

CLAY

(Including producers of crude clay; and manufacturers of brick, tile, porcelain, etc.)

Operator	Remarks	Address	Location of plant or pit
Alameda County			
California Pottery Co.	a, c	Niles	Niles
N. Clark & Sons Division Pacific Clay Products Co.	a, b	401 Pacific Ave., Alameda	Alameda
Interlocking Tile Co.	a	Niles	Niles
Henry J. Kaiser Co.	c	1924 Broadway, Oakland	Radum
Kraftile Co.	a, b, c	Niles	Niles
Merritt Supply Co.	a	P. O. Box 1, Sta. A, Berkeley	Berkeley
Amador County			
Cal. Mineral Products Co., Ione Clay and Sand Pit	c, f	Kohl Bldg., San Francisco	Ione
N. Clark & Sons Division, Pacific Clay Products Co.	c	401 Pacific Ave., Alameda	Ione
Gladding McBean & Co.	c	2901 Los Feliz Blvd., Los Angeles	Ione
Preston School of Industry	b	Ione	Ione
Western Refractories Co.	b, c	Russ Bldg., San Francisco	Ione
Calaveras County			
California Pottery Co.	c	Niles	Valley Springs
Contra Costa County			
American Radiator & Standard Sanitary Mfg. Co., H. W. Creeger, Mgr.	a	Box W, Richmond	Richmond
California Art Tile Corp'n	a	Box 1116, Richmond	Richmond
Gladding, McBean & Co.	b	2901 Los Feliz Blvd., Los Angeles	Pittsburg
Port Costa Brick Works, C. G. Berg, Pres.	b	6th and Berry Sts., San Francisco	Port Costa
Technical Porcelain & Chinaware Co.	a	Manila & Kearny Sts., El Cerrito	El Cerrito
United Materials & Richmond Brick Co., Ltd.	a, b	Box 7, Richmond	Richmond

Fresno County			
Craycroft Brick Co.	a, b, c	Belmont & Lafayette Sts., Fresno	Fresno
Humboldt County			
Hindley Clay Products	a, b, c	3839 Myrtle St., Cutten	Cutten
Inyo County			
Sierra Tale Co.	e	5509 Randolph Ave., Los Angeles	Olancha
Kern County			
American Minerals Co.	c	5601 S. Boyle, Los Angeles	Cantil
Bakersfield Sandstone Brick Co.	b	Bakersfield	Bakersfield
D. P. Covert	e	309 Bank of America Bldg., Glendale	
King Lumber Co.	b	Box 1559, Bakersfield	Bakersfield
Macco Construction Co., dba Antelope Materials Co.	d	815 Paramount Blvd., Clearwater	Rosamond
Los Angeles County			
American Container Co., Inc.	a	3132 Washington Blvd., Los Angeles 23	Los Angeles
Angulo Tile Co.	a, c	Reseda	Reseda
Atkinson Brick Co.	b	1360 Central Ave., Los Angeles	Los Angeles
J. A. Bauers Pottery Co.	a	415 W. Ave 33, Los Angeles	Los Angeles
J. Booth	a	1775 Stanford Ave., Santa Monica	Santa Monica
Builders Brick Co., Ltd.	b	17602 S. Western Ave., Moneta	Moneta & Compton
B. W. Tile Co.	a	14600 S. Western Ave., Gardena	Gardena
Coast Brick Co.	b	P. O. Box 326, Moneta	Moneta
H. F. Coors Co., Inc.	a	Inglewood	Inglewood
Davidson Brick Co.	b	4701 Floral Dr., Los Angeles	Los Angeles
General Refractories Co.	b	3363 Fruitland Road, Los Angeles	Los Angeles
Gladding McBean & Co., Tropico, L. A. & S. M. Plants	a, b, c	2901 Los Feliz Blvd., Los Angeles	Tropico, Los Angeles, Santa Monica, Hermosa Beach and Vernon
Higgins Brick & Tile Works	b	Box 525, Moneta	Moneta
Italian Terra Cotta Co.	a	1149 Mission Rd., Los Angeles	Los Angeles
Pacific Clay Products	a, b, c	Box 145, Sta. A, Los Angeles	Los Angeles and Los Nietos
Pacific Tile & Porcelain Co.	a	P. O. Box 638, Hynes	Hynes
Pomona Brick Co., S. Bernard Strona	b	Pomona	Pomona
Pomona Tile Mfg. Co.	a	629 N. La Brea Ave., Los Angeles	Pomona
St. Louis Fire Brick & Insulation Co.	b	3050 E. Slauson St., Huntington Park	Huntington Park
Simons Brick Co., Walter R. Simons	b	1195 S. Boyle Ave., Los Angeles	Los Angeles
Southwest Brick Co.	b	17601 S. Western Ave., Los Angeles	Los Angeles
San Valle Tile Kilns	a	1258 N. Highland Ave., Los Angeles	Reseda
Valley Brick & Supply Co.	b	6151 Kester Ave., Van Nuys	Van Nuys
Vernon Potteries	a	2300 E. 52nd St., Los Angeles	Vernon

a. Clay products. b. Brick and hollow building-tile. c. Crude clay. d. Oil-well drilling-mud. e. Filtering clay. f. Fire sand.

CLAY—Continued

(Including producers of crude clay; and manufacturers of brick, tile, porcelain, etc.)

Operator	Remarks	Address	Location of plant or pit
Marin County			
McNear Brick Co.	a, c	McNear Point, San Rafael	McNear
Orange County			
El Toro Clay Co., I. P. Arnold	c, f	655 W. 2nd St., Los Angeles	El Toro
La Bolsa Tile Co.	a, c	R.F.D. 1, Box 174, Huntington Beach	Smeltzer
Placer County			
Gladding, McBean & Co.	a, b, c	2901 Los Feliz Blvd., Los Angeles	Lincoln
Lincoln Clay Products Co.	c	P. O. Box 367, Lincoln	Lincoln
Riverside County			
Alberhill Coal & Clay Co.	c	Box 4267, Village St., Los Angeles	Alberhill
Los Angeles Brick Co.	a, b, c	1078 Mission Rd., Los Angeles	Alberhill
Pacific Clay Products	c	Box 145, Sta. A, Los Angeles	Corona
Temescal Clay Co.	c	2569 Clarendon Ave., Huntington Park	Temescal
Sacramento County			
Cannon & Co.	a, b, c	Box 802, Sacramento	Ben Ali
H. C. Muddox, Jessie E. Muddox, Owner	a	30th and L Sts., Sacramento	Sacramento
Panama Pottery Co.	a	R.F.D. 4, Box 1478, 24th St. Rd., Sacramento	Sacramento
Sacramento Brick Co.	b	1300 Front St., Sacramento	Sacramento
San Bernardino County			
Baroid Sales Div., National Lead Co.	d, e	830 Ducommun St., Los Angeles	Hector
Hancock Brick Yard, C. P. Hancock & Son	b	Box 421, Riverside	Highgrove
Gladding-McBean & Co.	c	2901 Los Feliz Blvd., Los Angeles	Goff
Master Mining Co.	c	530 W. 6th St., Los Angeles 14	Bryman
Pacific Bentonite Mine, Louis Martinez	e	Box 374, Red Mountain	Red Mountain
Southern California Minerals Co., W. K. Skeoch	c	320 S. Mission Rd., Los Angeles	Goff
San Diego County			
Union Brick Co., J. W. Rice	b	P. O. Box 356, North San Diego	Rose Canyon
San Joaquin County			
Laurel Potteries	a	McKinley Ave., Stockton	Stockton
Pacific Clay Products Co.	a, c	Box 145, Station A, Los Angeles	Stockton
San Joaquin Brick Co.	b	33 S. El Dorado St., Stockton	Stockton
Stockton Brick & Tile Co.	a	McKinley Ave., Stockton	Stockton

San Luis Obispo County			
San Luis Brick Works	d	San Luis Obispo	San Luis Obispo
Santa Barbara County			
McNall Building Materials	a, b	208 N. Salsipuedes, Santa Barbara	Santa Barbara
Santa Clara County			
Garden City Pottery	a	560 N. 6th St., San Jose	San Jose
Gladding Bros. Mfg. Co.	a, b, c	S. 3d and Keyes Sts., San Jose	San Jose
Myers Ceramic Pottery, F. Hinz	a	Box 97, Santa Clara	Santa Clara
Remillard-Dandini Co.	b	569 3d St., Oakland	San Jose
Stanislaus County			
Lester Raggio	e	Knights Ferry	Knights Ferry
Sutter County			
Gladding McBean & Co.	c	2901 Los Feliz Blvd., Los Angeles	Nicolaus
Ventura County			
Shell Oil Co., Dent Clay Pit	d	Shell Bldg., San Francisco	Ventura

a. Clay products. b. Brick and hollow building-tile. c. Crude clay. d. Oil-well drilling-mud. e. Filtering clay. f. Fire sand.

COAL

Operator	Address	Location of mine
Trinity County		
Trinity Coal Co., Wm. A. Mumford	Weaverville	Douglas City

COPPER

Principal copper producers in California in 1946 (not less than 10,000 pounds)

Mine	Operator	Address	Post office of mine
Amador County			
Newton	Pacific Mining Co.	417 S. Hill St., Los Angeles	Ione
Calaveras County			
Penn	Shawmut Copper Mine Co.	Campo Seco	Campo Seco
Union (tailings)	Pacific Mining Co.	1022 Crocker Bldg., San Francisco	Copperopolis
El Dorado County			
Pioneer Lilyama	Pioneer Lilyama Mines	Placerville	Placerville
Inyo County			
Columbia No. 2	Finley Co.	Tecopa	Tecopa
Darwin	Anaconda Copper Mining Co.	Darwin	Darwin
Modoc	L. D. Foreman	850 S. Fourth St., West, Salt Lake City, Utah	Trona
Pine Creek (Tungsten)	U. S. Vanadium Corporation	Laws	Laws
San Bernardino County			
Bagdad-Chase (Pacific)	Donald F. Love	Ludlow	Ludlow
Kelly and Juanita	F. W. Royer	Red Mountain	Red Mountain
Mohawk	Emerson A. Ray and Associates	Nipton	Nipton
Shasta County			
Hornet (Mattie Orebody)	The Mountain Copper Co., Ltd.	216 Pine St., San Francisco	Matheson

DIATOMITE (DIATOMACEOUS EARTH)

Operator	Address	Location of mine or quarry
Los Angeles County		
Great Lakes Carbon Corp., Dicalite Division	756 S. Broadway, Los Angeles 14	San Pedro
Modoc County		
H. W. Free	Tionesta	Tionesta
Santa Barbara County		
Johns-Manville Products Corp.	Lompoc	Lompoc

DOLOMITE

Operator	Address	Location of quarry
Inyo County		
Inyo Marble Co., D. H. Dunn, Pres.	726 E. 29th St., Los Angeles	Keeler
Monterey County		
Permanente Metals Corp.	Permanente	Natividad
San Benito County		
Archie E. Hamilton	Hollister	Hollister
Tuolumne County		
U. S. Lime Products Corp.	85 Second St., San Francisco	Sonora

FELDSPAR

Operator	Address	Location of mine
Madera County		
Almyra S. Anderson	1405 N. Fresno St., Fresno 4	Friant

GEMS AND JEWELERS' MATERIALS

Operator	Address	Variety
San Bernardino County		
H. F. Heather	236 S. Oak Knoll Ave., Pasadena	Agate
San Luis Obispo County		
Gordon Bowser	119 Beebee Street, San Luis Obispo	Sagenite Agate

GOLD

Principal gold producers, not less than 200 ounces in California, including placer and lode mines in 1946

Mine	Type of mine	Operator	Address	Post office of mine
Amador County				
Burke and Skagg Ranch	h	Mountain Gold Dredging Co.	3006 Pacific Ave., Stockton	Sutter Creek
Lilly (Garibaldi property)	h	Earnest L. Lilly	Plymouth	Plymouth
Peterson	a	Russell A. Donnelly	Pine Grove	Pine Grove
Butte County				
Boat No. 1	h	Hoosier Gulch Placers	1013 25th St., Sacramento	Oroville
Butte Unit	e	Yuba Consolidated Gold Fields	351 California St., San Francisco	Hammonton
Dredge No. 3	e	Lancha Plana Gold Dredging Co.	Lockeford	Chico
Kister dredge	e	Gold Hill Dredging Co.	311 California St., San Francisco	Oroville
Calaveras County				
Gomez, Roberts, Ponte, Cunes, Basco leases	h	Grant Mining Co.	Mokelumne Hill	Mokelumne Hill
Mountain King	a	Mountain King Mine	Copperopolis	Copperopolis
Oneta, Huberty, Guttinger	h	Walsco Dredging Co.	San Andreas	San Andreas
Penn	j	Shawmut Copper Mine Co.	Campo Seco	Campo Seco
Royal	a	Pacific Bridge Co., and Frank S. Tower	333 Kearny St., San Francisco	Milton
El Dorado County				
Boarman and S. P. properties	h	Richard H. Nelson	935 Forum Bldg., Sacramento	Shingle Springs
Browns Bar	h	French Corral Gold Dredging Co.	1053 25th St., Sacramento	Auburn
Cosumnes Mines, Inc.	a	Cosumnes Mines, Inc.	Grizzly Flats	Grizzly Flats
Ostenrider property	h	M. G. Henness and S. Legate	Georgetown	Georgetown
Pioneer-Lilyama	j	Pioneer Lilyama Mines	Placerville	Placerville
River Pine dredge	h	River Pine Mining Co.	Plymouth	Plymouth
Inyo County				
Columbia No. 2	m	Finley Co.	Tecopa	Tecopa
Darwin	m	Anaconda Copper Mining Co.	Darwin	Darwin
Pine Creek (tungsten)	r	U. S. Vanadium Corporation	Laws	Laws
Kern County				
Tropico-Yellow Dog-Standard Hill	a	Burton Bros.	Rosamond	Rosamond
Mariposa County				
Mount Gaines	a	Mount Gaines Mining Co.	Hornitos	Hornitos

Merced County				
Merced Dredge No. 1	e	Merced Dredging Co.	1805 Mills Tower, San Francisco	Snelling
Snelling Gold Dredge No. 1	e	Snelling Gold Dredging Co.	Snelling	Snelling
Mono County				
Benton	c	L. D. Foreman	850 South Fourth West St., Salt Lake City, Utah	Benton
Dogtown Placers	h	Sunmar Dredging Co.	Box 228, Oroville	Bridgeport
Nevada County				
Ancho-Erie Groups	a	Ancho-Erie Mining Co.	c/o Fred Anderson, Supt., 401 2nd St., San Francisco	Washington
Empire Star Group	a	Empire Star Mines Co., Ltd.	Grass Valley	Grass Valley
Idaho Maryland-New Brunswick	a	Idaho Maryland Mines Corporation	308 Russ Bldg., San Francisco	Grass Valley
Relief Hill	g	Western Gold, Inc.	942 Russ Bldg., San Francisco	North Bloomfield
Placer County				
Browns, Mammoth and Kennibee Bars	h	French Corral Gold Dredging Co.	1015 25th St., Sacramento	Auburn
Horseshoe Bar	b	Horseshoe Bar Mines	Foresthill	Foresthill
Sacramento County				
Capital Dredge	e	Capital Dredging Co.	351 California St., San Francisco	Fair Oaks
Fair Oaks Gravel Co.	k	Fair Oaks Gravel Co.	1401 42nd St., Sacramento	Fair Oaks
General Dredge No. 3	e	General Dredging Co.	Natoma	Natoma
Lancha Plana Dredge No. 4	e	Lancha Plana Gold Dredging Co.	Lockeford	Folsom
Natomas Dredge	e	Natomas Co.	Forum Bldg., Sacramento	Natoma
Thurman and Wright Dredge No. 4	e	Thurman and Wright	960 Russ Bldg., San Francisco	Sloughhouse
Wallace Dredge	e	Wallace Dredging Co.	311 California St., San Francisco	Camanche
San Bernardino County				
Bagdad-Chase (Pacific)	a	Donald F. Love	Ludlow	Ludlow
Carbonate King	s	Crystal Cave Mining Co.	Las Vegas	Nipton
Kelly and Juanita	b	F. W. Royer	Red Mountain	Red Mountain
Spud Patch	k	Hoefling Bros.	Box 768, Sacramento	Atolia
San Joaquin County				
Lower Camanche Dredge Upper Camanche Dredge	e	Gold Hill Dredging Co.	311 California St., San Francisco	Camanche
Shasta County				
Clear Creek	e	French Gulch Dredging Co.	French Gulch	French Gulch
Hornet (Mattie orebody)	j	The Mountain Copper Co., Ltd.	216 Pine St., San Francisco	Matheson
St. Jude	a	St. Jude Mining Co.	1222 Russ Bldg., San Francisco	French Gulch
Tadpole Creek	h	Sandra Gold Dredging Co.	Redding	Redding
Thurman Gold Dredge	e	Thurman Gold Dredging Co.	960 Russ Bldg., San Francisco	Redding
Sierra County				
Brush Creek	a	Alfred L. Merritt	453 Scenic Ave., Piedmont	Goodyears Bar
Original 16-1	a	Original Sixteen to One Mine, Inc.	1611 Russ Bldg., San Francisco	Alleghany

GOLD—Continued

Principal gold producers, not less than 200 ounces in California, including placer and lode mines in 1946

Mine	Type of mine	Operator	Address	Post office of mine
Siskiyou County				
Scandia 1-2-3	h	Larsen and Harmes	5261 Stockton Blvd., Sacramento	Horse Creek
Siskiyou Unit	e	Yuba Consolidated Gold Fields	351 California St., San Francisco	Callahan
Yreka Gold Dredge	e	Yreka Gold Dredging Co.	220 Montgomery St., San Francisco	Seiad Valley
Stanislaus County				
La Grange Dredge No. 4	e	La Grange Gold Dredging Co.	1805 Mills Tower, San Francisco	La Grange
Tuolumne Gold Dredge	e	Tuolumne Gold Dredging Co.	1 Sansome St., San Francisco	La Grange
Trinity County				
Carrville Gold Dredge	e	Carrville Gold Co.	351 California St., San Francisco	Trinity Center
Junction City Dredge	e	Junction City Mining Co.	685 6th St., San Francisco	Junction City
Northern California Mines	g	Goldfield Cons. Mines Co.	1225 Crocker 1st Nat'l Bank Bldg., San Francisco	Junction City
P & W	h	P & W Trinity Placers	Weaverville	Weaverville
Stuarts Fork	h	Thomson Divide Mg. Co.	1612 Oregon St., Redding	Minersville
Tuolumne County				
Eagle Shawmut	a	Miller and Clemsen	4800 Santa Fe Ave., Los Angeles	Chinese Camp
Yuba County				
Yuba Unit	e	Yuba Consolidated Gold Fields	351 California St., San Francisco	Hammonton

a. Lode, gold mine. b. Gold-silver mine. c. Tailings dumps. d. Pocket. e. Dredge (bucketline). f. Drift mine. g. Hydraulic mine. h. Dragline operations. j. Copper-gold mine. k. Power shovel or dry land dredge. m. Lead mine. n. Suction dredge. o. Zinc mine. p. Silver-lead-zinc. r. Tungsten mine. s. Copper-zinc mine. t. Gravel plant.

GRANITE

Operator	Product	Address	Location of quarry
Fresno County			
Superior-Academy Granite Co.	a	Clovis	Academy
Lassen County			
Greig Quarry, J. B. Wagender	a	Susanville	Susanville
Placer County			
Victor Wickman	a	Rocklin	Rocklin
Riverside County			
Emil Johnson	a	Perris	Perris
San Bernardino County			
Texas Quarries, Inc.	a	Box 605, Victorville	Victorville
San Diego County			
Crystal Black Quarry, John Stridsburg	a	Box 115, Escondido	Spooks Canyon
Pacific Cut Stone & Granite Co.	a	414 S. Marengo Ave., Alhambra	Escondido
Sonoma County			
S. Cabrol	b, c	Glen Ellen	Glen Ellen

a. Granite used in building and monumental stone. b. Tuff used as building stone. c. Volcanic rock used as flagstone and building stone.

GYPSUM

Operator	Address	Location of quarry
Alameda County		
Westvaco Chlorine Prod. Corp.*	Newark	Newark
Fresno County		
Agricultural Mineral & Fertilizer Co., A. D. Sousa	P. O. Box 832, Los Banos	Los Banos
Imperial County		
U. S. Gypsum Co.	300 W. Adams St., Chicago, Ill.	Plaster City
Kern County		
H. M. Holloway, Inc.	Box 310, Lost Hills	Lost Hills
Pacific Gypsum Co.	230 Columbus, Bakersfield	Conner
Western Gypsum Co.	733 Maple St., Wasco	McKittrick
Monterey County		
Monterey Gypsum Co., H. B. Scott	P. O. Box 900, Watsonville	King City
Riverside County		
United States Gypsum Co.	300 W. Adams St., Chicago 6, Illinois	Midland
Ventura County		
Monolith Portland Cement Co.	Bartlett Bldg., Los Angeles	Cuyama Valley

* Output not included in production figures as gypsum is by-product of chemical process using minerals already included in state total.

IODINE

Operator	Address	Mine
Los Angeles County		
Deepwater Chemical Co., Ltd.	Box 588, Compton	Compton
The Dow Chemical Co.	Midland, Mich.	Long Beach and Venice

IRON

Operator	Address	Location of mine
Los Angeles County		
Challoner Thompson	Sand Canyon Rt. 1, Saugus	Saugus
Riverside County		
Mineral Materials Co.	1145 Westminster Ave., Alhambra	Baxter
San Bernardino County		
Kaiser Co., Inc., Iron and Steel Division	P. O. Box 217, Fontana	Kelso
Mineral Materials Co.	1145 Westminster Ave., Alhambra	Blythe
Shasta County		
Shasta Iron, Carrico & Gautier	365 Ocean Ave., San Francisco	Heroult

LEAD

Principal lead producers in California in 1946 (not less than 10,000 pounds)

Mine	Operator	Address	Post office of mine
Calaveras County			
Penn	Shawmut Copper Co.	Campo Seco	Campo Seco
Inyo County			
Cerro Gordo	L. D. Foreman	850 S. 4th West St., Salt Lake City, Utah	Cerro Gordo
Columbia No. 2	Finley Co.	Tecopa	Tecopa
Darwin	Anaconda Copper Mining Co.	Darwin	Darwin
Empress	Dopplemayer & Crandell	Darwin	Darwin
Gold Bottom and Ophir	Damon and Damon	Trona	Trona
Last Chance	L. D. Foreman	850 S. 4th West St., Salt Lake City, Utah	Trona
Lead King	George Lippincott	P. O. Box 1811, Santa Ana	Cerro Gordo
Modoc	L. D. Foreman	850 S. 4th West St., Salt Lake City, Utah	Trona
Silver Spoon	Theodore Peterson	Darwin	Darwin
San Bernardino County			
Beverly Glenn	Arthur J. Ansite	Cima	Cima
C. & K.	C. & K. Mines	Dawes	San Bernardino
Calico (old tailings)	Louis Warnken, Jr.	Keeler	San Bernardino
Carbonate King	Crystal Cave Mining Co.	Las Vegas, Nevada	Nipton
Mohawk	Emerson A. Ray and Associates	Nipton	Nipton
War Eagle	War Eagle Mine	Amboy	Amboy
Shasta County			
Hornet (Mattie Orebody)	The Mountain Copper Co., Ltd.	216 Pine St., San Francisco	Matheson

LIME AND LIMESTONE

Operator	Product	Address	Location of quarry
Alameda County			
Westvaco Chlorine Prod. Corp.	a, d	Newark	Newark
El Dorado County			
Auburn Lime Products Co.	a, b	Box 231, Auburn	Auburn
California Rock & Gravel Co.	b	1800 Hobart Bldg., San Francisco	
Diamond Springs Lime Co.	a, b, c	Diamond Springs	Diamond Springs
El Dorado Limestone Co., J. H. Bell, Pres.	b	Shingle Springs	Shingle Springs
Fresno County			
Sierra Limestone Grits, Al Feuerstein	b	3863 Kershoff, Fresno 2	Fresno
Inyo County			
Blue Star Mines, Ltd.	b	Room 510, 810 S. Spring St., Los Angeles	Zurich
San Bernardino County			
Cal. Portland Cement Co.	a, b	601 W. Fifth St., Los Angeles	Colton
Chubbuck Lime Co., Chas. I. Chubbuck	a, b, c	4711 Worth St., Los Angeles	Chubbuck
Marter Mining Co.	b	530 W. Sixth St., Los Angeles	Lucerne Valley
Riverside Cement Co.	b	621 S. Hope St., Los Angeles	Oro Grande
Victorville Lime Rock Co.	b	Box 548, Victorville	Victorville
San Diego County			
San Diego Grit Co.	b	Box 54, Jacumba	Jacumba
San Mateo County			
Pacific Portland Cement Co.	c, d	417 Montgomery St., San Francisco	Redwood City
Santa Clara County			
Bay Shell Co.	c, d	503 Market St., San Francisco	Alviso
Beck Dredging Co.	c, d	305 Parrott Dr., San Mateo	Alviso
Permanente Cement Co.	b	Permanente	Permanente
Santa Cruz County			
Henry Cowell Lime and Cement Co	a, b	2 Market St., San Francisco	Santa Cruz
Pacific Limestone Prod. Co.	b, c	Spring St., Santa Cruz	Santa Cruz
Santa Cruz Portland Cement Co.	b	Crocker Bldg., San Francisco	Davenport
Tuolumne County			
Walter C. Sundburg	b	Box 653, Sonora	Sonora
U. S. Lime Products Corp.	a, b, c	57 Post St., San Francisco	Sonora
Ventura County			
Western Lime Products Co.	b, c	6305 Yucca St., Los Angeles	Santa Susana

a. Producer of burnt lime. b. Producer of limestone. c. Agricultural lime. d. Shells.

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LITHIA

Operator	Address	Location of mine
San Bernardino County		
American Potash & Chemical Corp.	Trona	Trona

MAGNESIA AND OTHER MAGNESIUM COMPOUNDS

Operator	Product	Address	Location of plant
Alameda County			
Westvaco Chlorine Prod. Corp.	Basic carbonate	405 Lexington Ave., New York, N. Y.	Newark
Monterey County			
The Permanente Metals Corp.	Oxide	Permanente	Moss Landing
San Diego County			
Westvaco Chlorine Prod. Corp.	Chloride	405 Lexington Ave., New York, N. Y.	San Diego
San Mateo County			
Marine Magnesium Prod. Corp., R. E. Clarke	Carbonate hydroxide and oxide	South San Francisco	South San Francisco
Plant Rubber and Asbestos Works	Carbonate	537 Brannan St., San Francisco	Redwood City

MARBLE

Operator	Product	Address	Location of quarry
San Bernardino County			
Rowe and Buehler	b	1555 Sunset Ave., Pasadena	Lavic
Sinrock Co., E. D. Rothrock	c	1316 Santiago Ave., Santa Ana	Yucca Valley
San Luis Obispo County			
Thomas C. Reynolds	b	Rt. 1A, Box 53, Paso Robles	Paso Robles

b. Limestone used as building stone and flagstone. c. Onyx.

MICA

Operator	Product	Address	Location of mine
Imperial County			
Western Non-metallic Co., C. F. Allebrand	a	Ogilby	Ogilby

a. Sericite mica schist.

MINERAL PAINT

Operator	Address	Location of property
San Bernardino County		
Rowe & Buehler	1555 Sunset Ave., Pasadena	Lavic

MINERAL WATER

Operator	Address	Location of spring
Butte County		
Richardson Mineral Springs	Richardson Springs	Richardson Springs
Calaveras County		
Mok-Hill Mineral Springs Seven Up Bottling Co.	1360 46th St., Sacramento 17	Mokelumne Hill
Contra Costa County		
Alhambra Water Co.	Martinez	Martinez
Fox Water Co.	675 37th St., Oakland	Oak Springs
Lake County		
Bartlett Springs	Bartlett Springs, via Williams	Bartlett Springs
Norman Mineral Springs, H. C. Norman, Mgr.	Middletown	Middletown
Witter Medical Springs, W. E. Whitaker	1265 Fourth Ave., San Francisco	Witter Springs
Los Angeles County		
Best Drinking Water	308 N. Oxford St., Los Angeles	Los Angeles
Deep Rock Artesian Water	4416 York Blvd., Los Angeles	Los Angeles
Elysian Spring Water Co.	1536 Baxter, Los Angeles	Los Angeles
Frespuro Artesian Water	4430 York Blvd., Los Angeles	Los Angeles
Indian Head Mineral Water	3640 N. Griffin Ave., Los Angeles	Los Angeles
Magnetic Spring Water Co.	939 Hancock Ave., Los Angeles	Los Angeles
Mountain Spring Water Co.	226 S. Avenue, Los Angeles 54	Los Angeles
Sparklett Bottled Water Corp.	4500 York Blvd., Los Angeles	Los Angeles
Marin County		
Purity Spring Water Co.	2032 Kearny St., San Francisco	
Napa County		
Calistoga Bottling Works, Ernest Mainini	Calistoga	Calistoga
Grigsby Soda Springs, T. B. Grigsby	Monticello	Monticello
Napa Soda, Inc.	25 Taylor St., San Francisco	Napa Soda Springs
Orange County		
La Vida Mineral Springs Co.	Route 1, Placentia	Carbon Canyon
Riverside County		
Beulah Springs, Oscar C. McNicholl	Arlington	Arlington
San Benito County		
San Benito Mineral Springs	Rt. 1, Box 306, Hollister	

MINERAL WATER—Continued

Operator	Address	Location of spring
San Bernardino County		
Arrowhead & Puritas Waters, Inc.	1566 E. Washington Blvd., Los Angeles 21	Arrowhead
San Diego County		
Rock Springs Co., L. H. Walck	Route 2, Box 224-A, Escondido	Escondido
San Francisco County		
Blue Crest Beverage Co.	285 Naples St., San Francisco	San Francisco
San Luis Obispo County		
New Crystal Spring Water Co., Ellen M. Hudson	Route 2, Box 11, San Luis Obispo	San Luis Obispo
Santa Barbara County		
Veronica Sales Co., Ltd.	P. O. Box 1002, Santa Barbara	Santa Barbara
Shasta County		
Hilltop Spring Water Co.	Redding	Shasta
Siskiyou County		
The Shasta Water Co.	6th and Brannan Sts., San Francisco 7	Dunsmuir
Sonoma County		
Barcal Springs, John Kolling	Cloverdale	Cloverdale
Tehama County		
Polk Springs	Box 154, Chico	Polk Springs

MOLYBDENUM ORE

Mine	Operator	Address	Location of mine
Inyo County			
Pine Creek Mine	United States Vanadium Corp.	30 E. 42nd St., New York, N. Y.	Bishop

PLATINUM

Operator	Address	Location of mine
Butte County		
Briggs Unit, Yuba Consolidated Gold Fields*	351 California Street, San Francisco	Oroville
Merced County		
Merced Dredging Co.*	Mills Bldg., San Francisco	Snelling
Sacramento County		
Capital Dredging Co.*	351 California St., San Francisco	
Natomas Co.*	Forum Bldg., Sacramento	Natoma
Siskiyou County		
Callahan Unit, Yuba Consolidated Gold Fields*	351 California St., San Francisco	Callahan
Stanislaus County		
La Grange Gold Dredging Co.*	Mills Bldg., San Francisco	La Grange
Trinity County		
Gilzean Hydraulic Mine	Junction City	Junction City
Junction City Mining Co.	Junction City	Junction City
Yuba County		
Yuba Consolidated Gold Fields*	351 California St., San Francisco	Hammonton

* Platinum metals not sold in 1946.

POTASH

Operator	Address	Location of plant
San Bernardino County		
American Potash and Chemical Co.	Trona	Trona

PUMICE AND VOLCANIC ASH

Operator	Product	Address	Location of property
Calaveras County			
Brownlite Products	a	701 Laurel St., Modesto	Valley Springs
Contra Costa County			
Diablo Pumibloc Co., Gieg Bros.	a	Rt. 1, Box 317, Pittsburg	Pittsburg
Pittsburg Pumice Industries	a	Rt. 2, Box 759, Pittsburg	Pittsburg
Inyo County			
Pacific Coast Pumice Co., C. W. Churchill	a	P. O. Box 656, Bishop	Bishop
Splane, Paul R.	a	13539 Hart St., Van Nuys	Inyokern
Western Talc Co.	a	1901 E. Slauson Ave., Los Angeles	Shoshone
Kern County			
Cudahy Packing Co.	b	803 Macy St., Los Angeles	Ceneda
Insulpum Corporation	a	406 S. Maine St., Los Angeles 13	Cantil
Madera County			
Calif. Industrial Minerals, c/o Forrest S. Taylor	b	Friant	Friant
Calif. Pumice Aggregate Co.	a	P. O. Box 1077, Madera	Friant
Erickson, Elmer	a	Box 98, Friant	Friant
Pacific Pumice Materials Co., W. E. Schlink	a	1047 N. Hunter St., Stockton	Friant
Pumice Industries	a, b	Tribune Tower, Oakland	Friant
Smith, Dave	a	P. O. Box 8, Friant	Friant
Modoc County			
Glass Mt. Volcolite Co., H. W. Free	a	Tionesta	Tionesta
Johnson, A. E., & Thompson, Paul	a	Tionesta	Tionesta
Timber Mt. Pumice Producers	a	Tionesta	Tionesta
Mono County			
U. S. Pumice Supply Co.	a	5509 Randolph St., Los Angeles 22	Leevining
Van Loon, H. A.	a	Bishop	Laws
Napa County			
Basalt Rock Co.	a	8th St., Napa	Napa
Cicero, C.	a	P. O. Box 446, Napa	Napa
Siskiyou County			
Fouch & Son, Roy	a	2236 College Ave., Berkeley 4	Tionesta
Glass Mt. Industries	d	434 S. 2nd St., Klamath Falls, Oregon	Tionesta
Glass Mt. Volcolite Co., H. W. Free	a, c, d	Tionesta	Glass Mountain
Miers, Allan	a	Tionesta	Tionesta

a. Pumice, aggregate. b. Volcanic ash. c. Scoria. d. Pumice for scouring brick.

PYRITES

Operator	Address	Location of mine
Shasta County		
The Mountain Copper Co., Ltd., Wm. F. Kett, Mgr.	216 Pine St., San Francisco	Matheson

QUICKSILVER

Principal producers in California for 1946 out of a total of 34 operating properties

Mine	Operator	Address	Location of mine
Contra Costa County			
Mt. Diablo	Bradley Mining Co.	Crocker Bldg., San Francisco	Clayton
Del Norte County			
Webb*	Oscar E. & Ed. Hanno	Crescent City	Patricks Creek
Webb	I. N. Shultz	224 N. Riverside, Medford, Oregon	Patricks Creek
Fresno County			
Archer	Archer Mining Co.	510 S. Spring St., Los Angeles	Coalinga
Lake County			
Abbott	International Metals Dev. Inc., C. O. Reed, Mgr.	Williams	Wilbur Springs
Great Western	Bradley Mining Co.	Crocker Bldg., San Francisco	Middletown
Helen	Scott Kline & L. S. Peterson	Middletown	Middletown
Sulphur Bank	Bradley Mining Co.	Crocker Bldg., San Francisco	Clearlake Park
Napa County			
Knoxville	Geo. E. Gamble (Owner)	1431 Waverly St., Palo Alto	Monticello
San Benito County			
New Idria	New Idria Quicksilver Mining Co.	Mills Bldg., San Francisco	Idria

* Sold to I. N. Schultz in 1946.

QUICKSILVER—Continued

Principal producers in California for 1946 out of a total of 34 operating properties

Mine	Operator	Address	Location of mine
San Luis Obispo County			
Klau	H. W. Gould & Co.	Mills Bldg., San Francisco	Adelaide
Polar Star	E. D. Rodgers	59 Laurent St., San Jose	San Simeon
Santa Barbara County			
Red Rock	National Mining & Milling Co.	1206 Maple Ave., Los Angeles	Los Olivos
Santa Clara County			
Guadalupe	Laco Mining Co., H. N. Mason	Rt. 3, Box 412, Los Gatos	Los Gatos
New Almaden	New Almaden Corp., C. N. Schuette, Gen. Mgr.	204 Sharon Bldg., San Francisco	Almaden
New Almaden Dump	Almaden Dumps	Almaden	Almaden
Sonoma County			
Culver Baer	C. A. Baumeister	Cloverdale	Cloverdale
Dewey's	Frank Dewey	Cloverdale	Geysers
Mt. Jackson	Sonoma Quicksilver Mines, Inc.	58 Sutter St., San Francisco	Guerneville
Yolo County			
Reed	Bradley Mining Co.	Crocker Bldg., San Francisco	Rumsey

SALT

Operator	Address	Location of plant
Alameda County		
American Salt Co.	341 Broadway, San Francisco	Mt. Eden
Leslie Salt Co.	310 Sansome St., San Francisco	Newark and Mt. Eden
Oliver Bros. Salt Co.	Mt. Eden	Mt. Eden
Imperial County		
Imperial Salt Co.	1245 National Ave., San Diego	Calipatria
Kern County		
Long Beach Salt Co.	2436 Hunter St., Los Angeles	Saltdale
Mono County		
C. C. Miller	837 W. Los Angeles St., Baldwin Park	Mono Lake
Monterey County		
Monterey Bay Salt Works, E. C. Vierra, Mgr.	Moss Landing	Moss Landing
Orange County		
The Irvine Co.	Tustin	Tustin
San Bernardino County		
California Rock-Salt Co.	2465 Hunter St., Los Angeles	Amboy
Desert Chemical Co.	4031 Goodwin Ave., Los Angeles	Amboy
San Diego County		
Western Salt Co.	1245 National Ave., San Diego	San Diego

SANDSTONE

Operator	Product	Address	Location of quarry
Los Angeles County			
Blue Goose Quarry, Robert Cox	b	1975 Lundy Ave., Pasadena	Pasadena
Monterey County			
Carmel Stone Quarry, A. L. Possadori	c	Box 185, Carmel	Carmel
Andrew Stewart	c	Carmel Valley	Carmel
Napa County			
H. F. Galbreath	b	957 Regal Road, Berkeley	
Santa Barbara County			
G. Antolini	a, b	131 E. Gutierrez St., Santa Barbara	Tajiguas

a. Dimension sandstone for building. b. Sandstone flagstone for building. c. Carmelstone for building.

SERPENTINE

Operator	Address	Location of quarry
Santa Clara County		
The Permanente Metals Corp.	Permanente	Almaden

SILLIMANITE GROUP

Operator	Product	Address	Location of mine
Imperial County			
Vitrefrax Co.	Kyanite	5050 Pacific St., Vernon, Los Angeles	Ogilby

SILICA

Operator	Product	Address	Location of mine
Contra Costa County			
Roberts Sand Co.	b	Box 323, Pittsburg	Pittsburg
Mariposa County			
The Permanente Metals Corp.	a	Permanente	La Grande
Monterey County			
Del Monte Properties	b	Del Monte	Pacific Grove
Owens-Illinois Glass Co.	b	P. O. Box 359, Pacific Grove	Pacific Grove
Riverside County			
Owens-Illinois Glass Co.	b	P. O. Box 298, Corona	Corona
San Bernardino County			
Mineral Materials Co., C. W. Dunton, Mgr.	c	1145 Westminster Ave., Alhambra	Oro Grande
Riverside Cement Co.	c	621 S. Hope St., Los Angeles	
San Diego County			
Crystal Silica Co.	b	717 E. 61st St., Los Angeles	Oceanside

a. Quartz. b. Glass sand. c. Quartzite.

SILVER

Principal silver producers in California in 1946

Mine	Type of mine	Operator	Address	Post office of mine
Amador County				
Newton	j	Pacific Mining Co.	417 S. Hill St., Los Angeles	Ione
Calaveras County				
Penn	j	Shawmut Copper Mine Co.	Campo Seco	Campo Seco
Inyo County				
Darwin	m	Anaconda Copper Mining Co.	Darwin	Darwin
Columbia No. 2	m	Finley Co.	Tecopa	Tecopa
Modoc	m	L. D. Foreman	850 S. Fourth West St., Salt Lake City, Utah	Trona
Pine Creek (Tungsten)	r	U. S. Vanadium Corporation	Laws	Laws
Kern County				
Tropico—Yellow Dog—Standard Hill	b	Burton Bros.	Rosamond	Mojave
Mono County				
Benton	c	L. D. Foreman	850 S. Fourth West St., Salt Lake City, Utah	Benton
Nevada County				
Empire Star Group	a	Empire Star Mines Co., Ltd.	Grass Valley	Grass Valley
Idaho Maryland-New Brunswick	a	Idaho Maryland Mines Corporation	308 Russ Bldg., San Francisco	Grass Valley
Orange County				
Silverado	p	Blue Light Silver Mines Co.	508 Chapman Bldg., Fullerton	Orange
Sacramento County				
Natomas Dredge	c	Natomas Co.	Forum Bldg., Sacramento	Natoma
San Bernardino County				
Bagdad-Chase (Pacific)	a	Donald F. Love	Ludlow	Ludlow
Calico	c	Louis Warnken, Jr.	Keeler	San Bernardino
Kelly and Juanita	b	F. W. Royer	Red Mountain	Red Mountain
Mohawk	m	Emerson A. Ray and Associates	Nipton	Nipton
Shasta County				
Hornet (Mattie Orebody)	j	The Mountain Copper Co., Ltd.	216 Pine St., San Francisco	Matheson
Yuba County				
Yuba Unit	e	Yuba Consolidated Gold Fields	351 California St., San Francisco	Hammonton

a. Lode gold mine. b. Gold-silver mine. c. Tailings dumps. e. Gold dredge. j. Copper-gold mine. m. Lead mine. p. Silver-lead-zinc. r. Tungsten mine.

SLATE

Operator	Product	Address	Location of quarry
El Dorado County			
Pacific Minerals Co., Ltd.	b, c	337 10th St., Richmond	Chili Bar
Placer County			
J. R. Hodgson	a	Box 88, Colfax	Colfax

a. Facing. b. Granules. c. Crude.

SODA

Operator	Product	Address	Location of plant
Inyo County			
Natural Soda Products Co.	a, d	506 Central Tower Bldg., San Francisco 4	Keeler
Pittsburgh Plate Glass Co., Columbia Chemical Division	a, d	Bartlett	Bartlett
San Bernardino County			
American Potash & Chemical Co.	a, c	Trona	Trona
Desert Chemical Co.	c	4031 Goodwin Ave., Los Angeles	Amboy
West End Chemical Co.	a	Latham Square Bldg., Oakland	West End

a. Soda ash. c. Salt cake. d. Trona.

STONE, MISCELLANEOUS

Under the heading of "miscellaneous stone" there are four divisions—crushed rock, grinding mill pebbles, paving blocks, and sand and gravel. Crushed rock includes crushed rock that is used in macadam, ballast and for concrete; also rock used for rubble and riprap.

NOTE—The California State Highway Commission, the various counties, U. S. Forest Service and U. S. Bureau of Public Roads produce both crushed rock and sand and gravel in various places in the state used in construction and maintenance of highways, but not specified in this listing.

Operator	Product	Address	Location of pit or quarry
Alameda County			
California Rock & Gravel Co.	a	1800 Hobart Bldg., San Francisco	Livermore
Easter Hill Properties Co.	b	First National Bank Bldg., Richmond	----------
Heafey-Moore Co., Leona Quarry	b	344 High St., Oakland	Oakland
Henry J. Kaiser Co.	a, b	Kaiser Bldg., 1924 Broadway, Oakland	Radum
Leslie Salt Co.	b	310 Sansome St., San Francisco	Newark
J. L. Martin	b	5921 Shepherd Canyon Rd., Oakland	Oakland
Niles Quarry Co.	b	406 Highland Blvd., Hayward	Hayward
Pacific Coast Aggregates, Inc.	a, b	400 Alabama St., San Francisco	Eliot and Niles
San Leandro Rock Co.	b	1150 Estudillo Ave., San Leandro	Lake Chabot
Superior Rock Co.	b	Broadway and McAdams St., Oakland	Oakland
Amador County			
Plymouth Rock Wool Co.	e	P. O. Box 127, Plymouth	Plymouth
Butte County			
Henry J. Kaiser Co.	a, b	1924 Broadway, Oakland	Oroville
Pacific Coast Aggregates, Inc.	a	400 Alabama St., San Francisco	Oroville
Pacific Gas & Electric Co.	b	245 Market St., San Francisco	----------
Calaveras County			
Neilsen Sand & Gravel Co., R. Neilsen	a	Box 14, San Andreas	San Andreas
Contra Costa County			
Antioch Asphalt Co.	a	1515 32nd Ave., San Francisco 22	Antioch
Atchison, Topeka & Santa Fe Railway Co.	a	121 E. Sixth St., Los Angeles 14	----------
Basalt Rock Co.	a	Eighth St., Napa	Antioch
Blake Bros., Anson Blake	b	Box 1002, Richmond	Point Richmond
Henry J. Kaiser Co.	a, b	1924 Broadway, Oakland	Antioch and Upton
Morris Sand Pit, Ben Morris	a	Antioch	Antioch
Roberts Sand Co.	c	Box 323, Pittsburg	Clayton
Slater Quarry, F. V. Slater	b	R.F.D. 1, Box 219, Martinez	Walnut Creek
El Dorado County			
Diamond Springs Lime Co.	b	Diamond Springs	Diamond Springs

Fresno County			
Atchison, Topeka & Santa Fe Railway Co.	b, g	121 E. Sixth St., Los Angeles 14	
Central Rock & Sand Co.	a, b	Sanger	Sanger
Grant-Pacific Rock Co.	a	Box 649, Fresno	El Prado
Herndon Rock Products Co.	a, b	410 Thorne St., Fresno	Herndon
Southern California Edison Co.	a, b	Edison Bldg., Los Angeles 53	
Volpa Bros.	a	Rt. 8, Box 175, Fresno	Fresno
Glenn County			
E. B. Bishop	a	Box 325, Orland	Wyo
Southern Pacific Co.	a	65 Market St., San Francisco	Wyo
Humboldt County			
Tom Hull	b	Eureka	Eureka
Mercer Fraser Co., Essex & Fernbridge	a	Second and Commercial Sts., Eureka	Eureka
Northwestern Pacific R. R. Co.	a	San Rafael	Sequoia
Imperial County			
Donald Cowan	a	El Centro	El Centro
Imperial Sand & Rock Co.	a	Brawley	Brawley
Lucien E. Smith Pipe Yard	a	Rt. 2, Box 270, El Centro	Seeley
Inyo County			
Mt. Whitney Rock Products, G. L. Watterson	a	Lone Pine	Lone Pine
Kern County			
Bakersfield Rock and Gravel Co.	a	Box 395, Station A, Bakersfield	Bakersfield
Edison Sand Co.	a	Box 395, Sta. A, Bakersfield	Bakersfield
Griffith Co.	a, b	Bakersfield	Bakersfield
Kern Rock Co., Ltd.	a, b	P. O. Box 1697, Bakersfield	Kern River
Lake County			
Frazell & Lampson	a	Lakeport	Lakeport
Lassen County			
M. J. Ruddy & Son	b	Modesto	Nubieber
Los Angeles County			
Arrow Rock Co.	a	Box 155, Monrovia	Monrovia
A. T. & S. F. R. R., I. L. Hibbard, Gen. Mgr.	a	121 E. Sixth St., Los Angeles 14	Forbes
Azusa Rock & Sand Co.	a, b	Rural Delivery, Azusa	Azusa
Richard R. Ball	a	Box 96, Walteria	Walteria
Harry E. Blood Co.	c	112 W. 9th St., Los Angeles 15	Los Angeles
Blue Diamond Corp., Ltd.	a	1650 S. Alameda St., Los Angeles	El Monte and Roscoe
Wm. J. Bonfield	g	2008 Laurel Canyon Rd., Los Angeles	Hollywood
Chandler Palos Verdes Sand & Gravel, L. Chandler	a	Lomita	Lomita
Consolidated Rock Products Co.	a, b	Box 2950 Terminal Annex or 2730 S. Alameda St., Los Angeles	Los Angeles, Azusa, Roscoe and Monrovia

a. Sand and gravel. b. Crushed rock (macadam, ballast, rubble, riprap, etc.). c. Molding sand. d. Granules for roofing, terrazzo. e. Slag and volcanic cinder. f. Tube-mill pebbles. g. Decomposed granite.

STONE, MISCELLANEOUS—Continued

Operator	Product	Address	Location of pit or quarry
Los Angeles County—Continued			
Graham Bros., Inc.	a, b	2000 N. Peck Road, El Monte	El Monte
W. F. Glaser, Inc.	b	13573 Romany Dr., Pacific	Brentwood Heights
John D. Gregg	a, b	Box 110, Whittier	Whittier
Lindauer Corp.	a	Box 337, La Habra	La Habra
Los Angeles Decomposed Granite Co.	g	2171 W. Washington, Los Angeles	Los Angeles
Manning Bros. Rock & Sand Co.	a, b	Irwindale	Irwindale
Mission Rock & Sand Co.	a	1172 La Presa Dr., San Gabriel	San Gabriel
Owl Rock Products Co.	a, b, g	P.O. Box 509 Monrovia	Monrovia
Pacific Rock & Gravel Co.	a, b	800 Lane Mortgage Bldg., 208 W. Eighth St., Los Angeles	
Edwin Sidebotham & Sons, Sidebotham Sand Plant	a	McFarland and L Sts., Wilmington	Lomita
Walter E. Wuesthoff	b	3208 Castera St., Glendale 8	Glendale
Marin County			
Basalt Rock Co.	b	Eighth St., Napa	McNear Point
Hutchinson Co.	b	Box 156, El Cerrito	San Quentin
Marin Gravel Co.	a	Point Reyes	Point Reyes
Mariposa County			
Yosemite National Park	a	Yosemite	Yosemite Nat'l Park
Mendocino County			
Ford Gravel Co., Kirby Ford	a	Ukiah	Ukiah
John Freitas	a, b	Ukiah	Ukiah
A. R. McEwing	a, b	Willits	Willits
Merced County			
J. C. Halbert	a	Winton	Winton
Los Banos Gravel Co.	a	Los Banos	Los Banos
Modoc County			
Great Northern Railway, T. A. Jerrow, Supt.	e	Klamath Falls, Ore.	Mammoth
Monterey County			
Del Monte Properties, C. S. Olmsted	a, c	Del Monte	Pacific Grove
Monterey Sands, Irving Kelly	a	Marina	Marina
Pacific Coast Aggregates, Inc.	a	85 Second St., San Francisco	Lapis and Pratteo
Napa County			
Basalt Rock Co.	b	Eighth St., Napa	Napa
Juarez Quarry, M. G. Reidenbach	b	Napa	Napa

Orange County			
Geo. T. Calhoun	a	P.O. Box 1741, Santa Ana	Garden Grove
California Rock Co.	a	Rural Delivery, Orange	Orange
Consolidated Rock Products Co.	a, b	2730 S. Alameda St., Los Angeles	Fullerton and Orange
Foster Sand & Gravel Co.	g	915 S. Spadra Rd., Fullerton	Fullerton
Fowler Sand & Gravel Co.	a	Rt. 1, Box 19-A, Orange	Santa Ana
V. J. Frye Foundry Supplies	c	1302 N. Flower St., Santa Ana	Santa Ana
Graham Bros., Inc.	a	2000 N. Peck Road, Los Angeles	San Juan Capistrano
D. D. Lawhead	g	Seal Beach	Seal Beach
Placer County			
J. R. Hodgson	b	Box 88, Colfax	Colfax
Union Granite Co., Ruhkala Bros.	b	Rocklin	Rocklin
Riverside County			
Guy F. Atkinson Co.	b	1103 Heartwell Bldg., Long Beach	Bly Junction
A. T. & S. F. R. R. Co., I. L. Hibbard, Gen. Mgr.	b	121 E. Sixth St., Los Angeles 14	Box Springs
Emil Johnson	b	Perris	Perris
Massey Rock & Sand Co.	a	Indio	Indio
Mission Indians	a	Palm Springs	Palm Springs
A. E. Sewabacher	g	610 Market St., San Francisco	
Service Rock Co.	a	Box 309, Riverside	Riverside
Transit Mixed Concrete Co.	a, b	3464 E. Foothill Blvd., Pasadena	Corona
Sacramento County			
American River Sand & Gravel Co.	a	P.O. Box 156, Perkins	Perkins
Brighton Sand & Gravel Co.	a, b	P.O. Box 2604, Sacramento	Sacramento
Canon & Co.	c	Box 281, Sacramento	Ben Ali
Del Paso Rock Products Co.	a, b	Rt. 6, Box 1200, Sacramento	Del Paso
Fair Oaks Gravel Co.	a	1401 42nd St., Sacramento 6	Fair Oaks
Pacific Coast Aggregates, Inc.	a, b	400 Alabama St., San Francisco 10	Fair Oaks, Mayhew and American River
Perkins Gravel Co.	a, b	Perkins	Perkins
Robert Powell & Co.	a	Box 815, Sacramento	American River
San Benito County			
Granite Rock Co.	b	Drawer M., Watsonville	Logan
San Bernardino County			
A. T. & S. F. R. R.	a, b	600 Kerckhoff Bldg., Los Angeles	Gale
Concrete Rock & Sand Co.	a	P.O. Box 149, Colton	Colton
Consolidated Rock Products Co.	a, b	2730 S. Alameda St., Los Angeles	Claremont
Geo. Herz & Co.	a	Base Line & Lytle Sts., San Bernardino	San Bernardino
Holiday Rock Co.	a	Upland	Upland
Palm Springs Builders' Supply Co.	a, b	682 S. Palm Canyon Dr., Palm Springs	Palm Springs
Redlands Gravel Co.	a	305 S. Buena Vista St., Redlands	Redlands
San Bernardino Rock & Gravel Co.	a	Box 249, San Bernardino	San Bernardino
Triangle Rock & Gravel Co.	a	San Bernardino	San Bernardino
Union Pacific Railroad Co.	a	2025 Hunter St., Los Angeles	Baxter

a. Sand and gravel. b. Crushed rock (macadam, ballast, rubble, riprap, etc.), c. Molding sand. d. Granules for roofing, terrazzo. e. Slag and volcanic cinder. f. Tube-mill pebbles. g. Decomposed granite.

STONE, MISCELLANEOUS—Continued

Operator	Product	Address	Location of pit or quarry
San Diego County			
Canyon Rock Co.	a, b	Box F, Hillcrest Sta., San Diego	San Diego
Claudell & Johnson	a	Box 246, Hillcrest Sta., San Diego	Mission Valley
Crystal Silica Co.	a, c, h	717 E. 61st St., Los Angeles	Oceanside
Escondido Sand & Gravel Works	a	Escondido	Escondido
H. G. Fenton Materials Co.	a	13th and Imperial Ave., San Diego	San Diego
H. M. Hubbard	c	2700 Barnson Pl., San Diego	San Diego
John T. Momand	f	P.O. Box 381, Carlsbad	Carlsbad
Nelson & Sloan	a	Box 832, Chula Vista	Chula Vista
San Francisco County			
Mission Quarry Co.	b	210 Balboa Bldg., San Francisco	San Francisco
San Joaquin County			
Frank B. Marks & Sons	a, b	203 Berverdor, Tracy	Tracy
Pacific Coast Aggregates, Inc.	a, b	400 Alabama St., San Francisco 10	Riverbank
Alfred Pereira	a, b	Tracy	Tracy
Putnam Sand & Gravel Co.	a	P.O. Box 486, Modesto	Riverbank
Tracy Rock & Gravel Co.	a	2101 Weber St., Stockton	Stockton
San Luis Obispo County			
Guiton Molding Sand, Harold E. Guiton	c	Oceano	Oceano
Walter B. Roselip	a	615 Grand Ave., San Luis Obispo	Atascadero
Southern Pacific Milling Co.	a	Santa Barbara Ave., San Luis Obispo	San Luis Obispo
San Mateo County			
A. & B. Quarry	b	P.O. Box 1037, Redwood City	Woodside
Brisbane Rock Co.	b	Guadalupe Valley, Brisbane	Brisbane
Brumley-Donaldson Co.	c	Rialto Bldg., San Francisco	South San Francisco
Canadas Quarry, California Paving Co.	b	1406 Third Ave., San Mateo	Half Moon Bay
Golden West Quarry	b	Geneva Ave. and Santos St., San Francisco 24	Daly City
Holy Cross Cemetery	b	Colma	Colma
Macco-Morrison-Knudsen Co.	b	P.O. Box 207, San Bruno	Milbrae
Rockaway Quarry, Inc.	a, b	Rockaway Beach	Rockaway Beach
Ken Royce	b	185 Bayshore Blvd., San Francisco	Rockaway Beach
Shoreland Co.	b	Pescadero	Pescadero
W. O. Tyson	b	345 Hilton, Redwood City	Belmont
Santa Barbara County			
Henry G. Petersen, d.b.a. Buell Flat Rock Co.	b	Solvang	Solvang

Santa Clara County			
Los Gatos Sand and Gravel Co.	a	Los Gatos	Los Gatos
George Neary	b	Rt. 1, Box 604, Los Altos	Los Altos
Pacific Coast Aggregates, Inc.	a, b	400 Alabama St., San Francisco	Coyote and Campbell, San Jose
Permanente Cement Co.	b	Permanente	Permanente
A. J. Raisch Paving Co.	a	900 W. San Carlos St., San Jose	San Jose
Rhodes & Robinson, Stanford Quarry	b	Box 325, Palo Alto	Palo Alto
Western Gravel Corp.	b	P.O. Box 855, Campbell	Campbell
Santa Cruz County			
Henry J. Kaiser Co.	a	1924 Broadway, Oakland	Olympia
Pacific Coast Aggregates, Inc.	a	400 Alabama St., San Francisco	Olympia
Santa Cruz Portland Cement Co.	b	Crocker Bldg., San Francisco	Davenport
Shasta County			
J. H. Hein Co.	a, b	Redding	Redding
City of Redding	a, b	Redding	Redding
Siskiyou County			
John S. Jensen	a	Mt. Shasta	Mt. Shasta
A. E. Kottinger*	b	Mt. Shasta	Mt. Shasta
Southern Pacific R. R. Co., Ass't Chief Engineer	e	Southern Pacific Bldg., San Francisco	Kegg
A. Young	a	345 N. Main St., Yreka	Yreka
Solano County			
J. M. Nelson, Cordelia Quarry	b	Cordelia	Cordelia
Sonoma County			
Basalt Rock Co.	a	Eighth St., Napa	Healdsburg
Hein Bros. Basalt Rock Co., Mark Hein, Pres.	b	Petaluma	Petaluma
R. D. Pelloch	b	Rt. 3, Box 615, Sebastopol	Sebastopol
John C. Spaletta	b	P.O. Box 442, Santa Rosa	Santa Rosa
Stony Point Quarry, W. A. Wilson	b	Petaluma, Star Route	Stony Point
Taylor Gravel Co., Harvey Taylor	a	Healdsburg	Healdsburg
Stanislaus County			
Tony Francisco	a	Crows Landing	Crows Landing
Gravel Products Co.	a	Hughson	Hughson
Wes Haslan	a, b	Oakdale	Oakdale
Hughson Gravel Co.	a	301 N. Santa Cruz Ave., Modesto	Hughson
Johnson Bros.	a	P.O. Box 123, Modesto	Modesto
Frank B. Marks & Sons	a	203 Berverdor St., Tracy	Newman
Oakdale Irrigation Dist.	a	Oakdale	Oakdale
Putnam Sand & Gravel Co.	a	P.O. Box 486, Modesto	Modesto
J. P. Scanlon, Scanlon Gravel Pit	a	Patterson	Crows Landing
C. Skove & J. Wychopen	a	Rt. 1, Box 27, Turlock	Turlock
Chas. Warner	a	Modesto	Modesto

* Sold to John S. Jensen in August 1946.

a. Sand and gravel. b. Crushed rock (macadam, ballast, rubble, riprap, etc.). c. Molding sand. d. Granules for roofing, terrazzo. e. Slag and volcanic cinder. f. Tube-mill pebbles. g. Decomposed granite. h. Filter and glass sand.

STONE, MISCELLANEOUS—Continued

Operator	Product	Address	Location of pit or quarry
Tehama County			
Archie Draper & Floyd Adams	a	Red Bluff	Red Bluff
Trinity County			
Northwestern Pacific R. R. Co., Wm. N. Neff, Gen. Sup't	b	Sausalito	Island Mountain
Tulare County			
Grant-Pacific Rock Co.	a, b	P.O. Box 649, Fresno	Lindsay
O. C. Jeffers	a	1032 River Rd., Porterville	Porterville
Tuolumne County			
Beerman & Jones	b	Sonora	Soulsbyville
Ventura County			
Montalvo Rock Co.	a, b	Box 188, Montalvo	Montalvo
Saticoy Rock Products Co.	a, b	Box 970, Ventura	Saticoy-Ventura
Ventura Molding Sand Co., O. D. Messmore	c	182 W. Simpson St., Ventura	Ventura
Yolo County			
Leroy Kerr	a	Yolo	Yolo
Joe Schwarzgruber	a	Woodland	Woodland
George Summers	a	Woodland	Woodland
		810 Elm St., Woodland	
Yuba County			
Hallwood Sand & Gravel Co.	a	711 Wilkie Way, Yuba City	Marysville
Hemstreet & Bell	a, b	411 C St., Marysville	Marysville
Pacific Coast Aggregates, Inc.	a	400 Alabama St., San Francisco 10	Marysville
Yuba River Sand Co.	a	Marysville	Marysville

a. Sand and gravel. b. Crushed rock (macadam, ballast, rubble, riprap, etc.), c. Molding sand. d. Granules for roofing, terrazzo. e. Slag and volcanic cinder. f. Tube-mill pebbles. g. Decomposed granite.

STRONTIUM

Operator	Address	Location of mine
Imperial County		
Pan-Chemical Co., John A. Stevens	1396 N. Harvard St., Claremont	Fish Mtn.
San Bernardino County		
Rowe-Buehler Mining Co., Wesley N. Rowe	919 E. Valley Blvd., Rosemead	Lavic

SULPHUR

Operator	Address	Location of mine
Alpine County		
Siskon Mining Corp., Hugh Wright, Gen. Mgr.*	Markleeville	Markleeville
Inyo County		
Crater Group, R. E. Kitching	Big Pine	Big Pine
S. & M. Minerals Co., B. J. Miche	P. O. Box 651, Big Pine	Big Pine

* Development work only, no shipments made during year.

TALC AND SOAPSTONE

Operator	Product	Address	Location of mine
El Dorado County			
Pacific Minerals Co., Ltd.	a	337 10th St., Richmond	Shingle
Inyo County			
Blue Star Mines, Ltd.	b	810 S. Spring St., Los Angeles	Kingston Mountain
Daniels, Cordelia	b	Darwin	Darwin
Desert Talc & Clay Co.	b	Pomona	Keeler
Gray & Stanley	b	Lone Pine	Keeler
Lane & Nicolaus	b	Big Pine	Big Pine
Sierra Talc Co.	b	5509 Randolph St., Los Angeles 22	Keeler
Viking Talc Mine	b	929 S. Detroit St., Los Angeles 36	Keeler
White Mt. Talc Co.	b	Lone Pine	Keeler
Mono County			
Huntley Mines	c	P. O. Box 485, Bishop	Laws
San Bernardino County			
Monarch Talc Mines	b	649 Olive St., Los Angeles	Shoshone
Sierra Talc Co.	b	5509 Randolph St., Los Angeles 22	Silver Lake
Southern Calif. Minerals Co., W. S. Skeoch	b	320 S. Mission Rd., Los Angeles	Cima & Shoshone
Western Talc Co.	b	1901 E. Slauson Ave., Los Angeles	Death Valley
San Diego County			
Pioneer Pyrophyllite	c	Chula Vista	Rancho Santa Fe
Shasta County			
Ganim, Joe S.	b	Schilling	Schilling

a. Soapstone. b. Talc. c. Pyrophyllite.

TITANIUM

Operator	Address	Location of mine
Los Angeles County		
Chaloner Thompson	Sand Canyon Rt. 1, Saugus	Saugus

TUNGSTEN

Mine	Operator	Address	Location of mine
Alpine County			
Alpine	Alpine Mining Co.*	5th & Cottage, San Rafael	Markleeville
Fresno County			
Garnet Dike	Sheridan & Bennett	Kings River Hatchery	Kings River
Inyo County			
Darwin	Anaconda Copper Mining Co.*	Box 58, Darwin	Darwin
Brownstone	El Diablo Mining Co.	Box 567, Bishop	Bishop
Hanging Valley	Hanging Valley Tungsten Co.*	Box 61, Bishop	Bishop
Pine Creek	U. S. Vanadium Co.	30 E. 42nd St., New York, N. Y.	Bishop
Kern County			
Beebe	Beebe Mining Co.	1807 N. Lima St., Burbank	Isabella
Pine Tree	Claussenius, C. H.*	Box 337, Tehachapi	Tehachapi
Mono County			
Black Rock	Beauregard, A. E., S. H., John	Bishop	Benton
San Bernardino County			
Spud Patch Placers & Atolia	Surcease Mining Co.	1820 D Street, Sacramento	Atolia
Tulare County			
Harrell Hill	Consolidated Tungsten Co.	Box 366, Dinuba	Dinuba
Herbert	Herbert Mines	Rt. 5, Box 150A, Porterville	Porterville
Big Jim	Tulare County Tungsten Mine	1855 Industrial St., Los Angeles	Lindsay

* Mined tungsten ore but did not ship.

ZINC

Principal producers of zinc in California in 1946 (not less than 10,000 pounds)

Mine	Operator	Address	Post office of mine
Calaveras County			
Penn	Shawmut Copper Mine Co.	Campo Seco	Campo Seco
Inyo County			
Darwin	Anaconda Copper Mining Co.	Darwin	Darwin
Gold Bottom & Ophir	Damon & Damon	Trona	Trona
Lead King	George Lippincott	P. O. Box 1811, Santa Ana	Cerro Gordo
San Bernardino County			
Carbonate King	Crystal Cave Mining Co.	Las Vegas, Nevada	Nipton
Mohawk	Emerson A. Ray and Associates	Nipton	Nipton
Shasta County			
Hornet (Mattie Orebody)	The Mountain Copper Co., Ltd.	216 Pine St., San Francisco	Matheson

LIST OF SMELTERS REPORTING PURCHASE OF CALIFORNIA METALS PRODUCED IN 1946

Name	Address	Location of plant	Metals reported purchased
American Smelting & Ref. Co.	120 Broadway, New York, N. Y.	Garfield, Utah	Copper, Lead, Gold, Silver
American Smelting & Ref. Co.	120 Broadway, New York, N. Y.	Hayden, Arizona	Copper, Gold, Silver
American Smelting & Ref. Co.	120 Broadway, New York, N. Y.	Murray, Utah	Lead, Copper, Gold, Silver
American Smelting & Ref. Co.	405 Montgomery St., San Francisco	Selby, Cal.	Copper, Lead, Gold, Silver
American Smelting & Ref. Co.	120 Broadway, New York, N. Y.	Tacoma, Wash.	Copper, Lead, Gold, Silver
Anaconda Copper Mining Co.	25 Broadway, New York 4, N. Y.	Great Falls, Mont.	Copper, Lead, Zinc, Gold, Silver
C. L. Ach	2709 Birch St., Alhambra	Alhambra	Tungsten
Bethlehem Pacific Coast Steel Corporation	20th & Illinois Sts., San Francisco	San Francisco	Iron ore
Bradley & Ekstrom	320 Market St., San Francisco	San Francisco	Manganese
Braun Corporation	2260 E. 15th St., Los Angeles	Los Angeles	Quicksilver
Coast Chemical Division F. W. Berk & Co., Inc.	Sharon Bldg., San Francisco	San Francisco	Quicksilver
International Smelting & Ref. Co.	Kearns Bldg., Salt Lake City, Utah	Tooele, Utah	Copper, Lead, Zinc, Gold, Silver
Kaiser Co., Inc.	P.O. Box 217, Fontana	Fontana	Iron Ore, Manganese Ore, Chromite
Mefford Chemical Co.	1026 Santa Fe, Los Angeles	Los Angeles	Quicksilver
Pacific Vegetable Oil Co., Bernard T. Rocca	62 Townsend St., San Francisco	San Francisco	Quicksilver
Quicksilver Producers Ass'n, Irving Ballard, Sec'y	407 Sansome St., San Francisco	San Francisco	Quicksilver
Sullivan Mining Co.	Kellogg, Idaho	Silver King, Idaho	Copper, Lead, Zinc, Gold, Silver
Twining Laboratores	2527 Fresno St., Fresno	Fresno	Tungsten ore
U. S. Mint	Duboce & Market Sts., San Francisco	San Francisco	Gold, Silver
U. S. Smelting, Refining & Mining Co.	Newhouse Bldg., Salt Lake City, Utah	Midvale, Utah	Copper, Lead, Zinc, Gold, Silver
Western Gold & Platinum Works	589 Bryant St., San Francisco	San Francisco	Platinum, Gold, Silver*
Wildberg Bros. Smelting & Ref. Co.	742 Market St., San Francisco	San Francisco	Platinum, Gold, Silver*

* Gold and silver in special high-grade ores only.

LIST OF CUSTOM MILLS AND COMMERCIAL GRINDING PLANTS IN CALIFORNIA

Firm	Type of Grinding
American Minerals Co., 5601 S. Boyle Ave., Los Angeles 11, Calif.	Commercial grinding of minerals.
Bishop Concentrate & Cleaning Co., Bishop, Calif.	Custom mill; purchases tungsten ores and base metal ores.
Burton Bros., Rosamond, Calif.	Custom cyanide mill. Gold and silver ores purchased.
California Talc, Inc., 830 Ducommun St., Los Angeles, Calif.	Talc and other soft non-metallic minerals ground by contract or purchased.
Commercial Minerals Co., 310 Irwin St., San Francisco, Calif.	Commercial grinding.
Hidecker Brick Co., 2500 E. 8th St., Los Angeles, Calif.	Clay grinding plant.
Industrial Minerals & Chemical Co., 6th & Gilman Sts., Berkeley, Calif.	Non-metallic minerals ground by contract or purchased.
Kennedy Minerals Co., 2550 E. Olympic Blvd., Los Angeles, Calif.	Non-metallic minerals ground by contract or purchased.
Ontario Rock Milling Co., 2710 Frederick St., Los Angeles, Calif.	Non-metallic minerals ground by contract or purchased. Roofing granules prepared.
Pacific Minerals Co., Ltd., 337 10th St., Richmond, Calif.	Non-metallic minerals ground by contract or purchased.
Pan-Chemical Co., 1400 Palomares St., Pomona, Calif.	Non-metallic mineral grinding plant operates on owned or purchased minerals.
Products Separating Corp., 6001 Gramercy Place, Los Angeles, Calif.	Non-metallic mineral grinding plant; contract or purchased.
Henry Rising & Co., 626 St. Paul, Los Angeles, Calif.	Non-metallic mineral grinding plant.
Southern California Minerals Co., 320 S. Mission Road, Los Angeles, Calif.	Non-metallic mineral grinding plant; contract or purchased.
Standard Minerals Co., 2455 E. 57th St., Los Angeles, Calif.	Non-metallic mineral grinding plant; contract or purchased.
Twining Laboratories, 2527 Fresno St., Fresno, Calif.	Purchase and concentrate tungsten ores on a custom basis, also commercial grinding.
Western Talc Co., 1901 E. Slauson Ave., Los Angeles, Calif.	Non-metallic mineral grinding plant; contract or purchased.

LIST OF QUICKSILVER BUYERS AND MINERAL BROKERS

Quicksilver Buyers

American Potash & Chemical Corp.,
609 S. Grand Ave.,
Los Angeles, Cal.

Atlas Powder Co.,
No. 1 Montgomery St.,
San Francisco, Cal.

Atkins, Kroll & Co.,
277 Pine St.,
San Francisco, Cal.

F. W. Berk & Co., Coast Chemical Division,
55 New Montgomery St.,
San Francisco, Cal.

Braun Corporation,
2260 E. 15th St.,
Los Angeles, Cal.

H. W. Gould & Co.,
Mills Bldg.,
San Francisco, Cal.

Los Angeles Chemical Co.,
1960 South Santa Fe Ave.,
Los Angeles, Cal.

Mefford Chemical Co.,
1026 Santa Fe Ave.,
Los Angeles, Cal.

Pacific Vegetable Oil Co.,
407 Sansome St.,
San Francisco, Cal.

Quicksilver Producers Association,
407 Sansome St.,
San Francisco, Cal.

Mineral Brokers

Atkins, Kroll & Co., 277 Pine St., San Francisco, Cal.	Dealers in tungsten ores, mercury, gypsum and limerock.
Bay Chemical Trading & Transport, 651 Howard St., San Francisco, Cal.	Dealers in metals and ores.
Harry E. Blood Co., 112 W. 9th St., Los Angeles, Cal.	Dealers in industrial sand and silica products.
Bond Bros. & Co., 25 California St., San Francisco, Cal.	Dealers in export minerals.
Bradley & Ekstrom, 320 Market St., San Francisco, Cal.	Dealers in all commercial minerals.
Braun-Knecht-Heimann Co., 1400 16th St., San Francisco, Cal.	Dealers in processed non-metallic minerals.
Bruan Corp., 2260 E. 15th St., Los Angeles, Cal.	Dealers in processed non-metallic minerals.
L. H. Butcher Co., 3628E. Olympic Blvd., Los Angeles, Cal.	Dealers in commercial minerals and metals.
California Export Co., Ferry Bldg., San Francisco, Cal.	Dealers in minerals for export.
Chamberlain Co., 4700 District Blvd., Los Angeles, Cal.	Dealers in fluorspar.

LIST OF COMMERCIAL ASSAY AND TESTING LABORATORIES

San Francisco Area

Ball, C. M.
615 University Ave.,
Berkeley

Curtis & Thomkins,
236 Front St.,
San Francisco

Hall Laboratories, Inc.,
149 California St.,
San Francisco

Hanks, Abbott, A., Inc.,
624 Sacramento St.,
San Francisco

Hersey Inspection Bureau (engineers, chemists, and testers of building materials),
3405 Piedmont Ave., Oakland

Hunt, Robert W., Co.,
251 Kearny St.,
San Francisco

Metallurgical Laboratories,
604 Mission St.,
San Francisco

Multiphase, Inc.,
351 Eighth St.,
San Francisco

Pacific Chemical Laboratories,
617 Montgomery St.,
San Francisco

Pittsburg Testing Laboratories,
651 Howard St.,
San Francisco

Straub Manufacturing Co.,
507 Chestnut St.,
Oakland

Western Analytical Bureau,
690 Market St.,
San Francisco

Western Gold and Platinum Works,
589 Bryant St.,
San Francisco

Wildberg Bros.,
742 Market St.,
San Francisco

Los Angeles Area

Atkin & McRae,
111 W. 11th St.,
Los Angeles

California Testing Laboratories, Inc.,
1429 Santa Fe Ave.,
Los Angeles

Eisenhauer, Ed, Jr.,
322 S. San Pedro St.,
Los Angeles

Fess, Edward E.,
5905 Pacific Blvd.,
Huntington Park

Groch Engineering Co.,
624 W. Ninth St.,
Los Angeles

Herman, John
920 Santee St.,
Los Angeles

Herr, A. V.,
5176 Hollywood Blvd.,
Los Angeles

Kennard & Drake,
4686 S. Santa Fe Ave.,
Los Angeles

Lewis & Walker,
111 W. 11th St.,
Los Angeles

Los Angeles Testing Laboratory,
1300 S. Los Angeles St.,
Los Angeles

Meco Assayers,
417 S. Hill St.,
Los Angeles

Minerals Engineering,
417 S. Hill St.,
Los Angeles

Osborne, Raymond G.,
110 W. Ninth St.,
Los Angeles

Pacific Platinum Works,
814 S. Spring St.,
Los Angeles

Perez, R. A., Co.,
920 Santee St.,
Los Angeles

Research Chemicals Laboratories (rare-earth analysis and research work),
831 N. Lake St.,
Burbank

Sill, Harley A.,
1011 S. Figueroa St.,
Los Angeles

Smith-Emery Co.,
920 Santee St.,
Los Angeles

von Huene, Rudolph,
865 N. Mentor Ave.,
Pasadena (thin sections)

Ward, Paul,
605 Mission St.,
South Pasadena (ceramic testing)

LIST OF COMMERCIAL ASSAY AND TESTING LABORATORIES—Continued

Other Areas

Bishop Assay and Engineering Office,
318 N. Main St.,
Bishop

Brooks, Alan M.,
Box 893,
Chula Vista

Clarkson Laboratories,
724 Seventh Ave.,
San Diego

Coast Laboratory,
1859 S. Van Ness Ave.,
Fresno

Daily Chemical Laboratory,
Box 228,
Oroville

Dietrich, Morse & Associates,
316 16th St.,
Sacramento

Draper, Hall D.,
Pine and Commercial Sts.,
Nevada City

Hornkohl Laboratories,
716 Truxton Ave., Box 1673,
Bakersfield

Ott, E. J. N.,
130 Main St.,
Nevada City

Raggio, A. J.,
Jackson

Rombaugh, M. D.,
3069 Del Paso Blvd.,
North Sacramento

San Joaquin Research Laboratory,
8 W. Weber St., Box 1987,
Stockton

Scheave, Harold,
232 Commercial St.,
Nevada City

Smith-Emery Co.,
Administration Bldg., Balboa Park,
San Diego

Twining Laboratories,
2527 Fresno St., Box 1472,
Fresno

Wallace's Lapidary & Assay Office,
Box 344,
El Centro

Warford, J. W.,
Mariposa

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